Issued April 10, 1915.

United States Department of Agriculture,

OFFICE OF THE SECRETARY.

Report No. 100.

[Contribution from the Bureau of Soils, Milton Whitney, Chief.]

POTASH FROM KELP.

BY

FRANK K. CAMERON,

In charge Chemical, Physical, and Fertilizer Investigations

Part I.—Pacific Kelp Beds as a Source of Potassium Salts.—By Frank K. Cameron.

Part II.—The Kelp Beds from Lower California to Puget Sound.—By W. C. Crandall, Collaborator in Kelp Investigations.

Part III.—The Kelp Beds of Puget Sound.—By George B. Rigg.

Part IV.—The Kelp Beds of Southeast Alaska.—By T. C. Frye.

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Soils,
Washington, D. C., August 15, 1914.

Sir: In the bill making appropriations for the Department of Agriculture for the fiscal year ending June 30, 1915, authority is provided to print and publish certain maps and accompanying reports relating to the kelp beds on the Pacific coast.

I have the honor to transmit for publication the manuscript copies of these maps and reports.

Respectfully,

Milton Whitney,
Chief of Bureau.

Hon. D. F. Houston,
Secretary of Agriculture.

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(In portfolio.)

POTASH FROM KELP.

I. PACIFIC KELP BEDS AS A SOURCE OF POTASSIUM SALTS.

By Frank K. Cameron,
Scientist in Soil Laboratory Investigations.

INTRODUCTION.

It is traditional in European countries for the several Governments to maintain a peculiarly active interest in the salt supplies, this state of affairs being especially well exemplified in the historical "salt monopolies" by which the Governments were assured of a certain revenue from a necessity for every citizen. About 1845 the German Government authorities, in an effort to increase the output of salt from the Magdeburg-Halberstadt region (better known as the Stassfurt region), drilled into the salt-bearing strata. Ultimately the main body of rock salt was penetrated, but in the upper layers or overburden there were found to be large quantities of "bitter" salts, or a mixture of potassium and magnesium salts, which, designated as "Abraumsalze," were regarded as worthless impedimenta. About 1870, mainly under the influence of the savant, Liebig, the value of the bitter salts as a soil amendment or fertilizer was established, and from that time the potash salts have been the most valuable output of the mines. The use of potash salts has become widespread throughout the world wherever intensive agricultural methods and fertilizers are employed.

POTASH FROM GERMANY.

Practically, and with a few comparatively unimportant exceptions, the world's supply has always come from the German mines, and the Government as a practical conservation measure regulates and controls the mining and sale of the products. The material is marketed through the Kali Syndikat, made up from all the mine ownerships and under the supervision of governmental officials, the amount that may be produced and marketed being allotted amongst the mines and prices fixed by the Syndikat, with the general restriction that no greater amount shall be exported than is sold in the German

Empire, except under a heavy export tax. The United States receives about one-fifth of the entire output of the German mines and more than half of the amount exported.

Salt mines containing workable amounts of potash are known elsewhere in Europe: at Kaluz, in Galicia, Hungary; in Belgium; and in Elsass (Upper Alsatia). A small deposit has also been reported from Chile. None of these as yet appreciably affect the world's supply or furnish any potash to America, but the possibilities of the Alsatian deposits have recently been attracting considerable attention.[1]

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[1] Potash, Results of Investigations of the Deposits of Upper Alsatia, by B. Förster, Mitt. Geol. Landessanst. Elsass-Lothr., 7, 349–524 (1911). The following is taken from a recent consular report by M. Jewett, American Consul, Kehl, Germany:

"The potash mines (kali) of Alsace-Lorraine are of recent development, but they bid fair to become a very important element in the economic life of this part of the German Empire, which enjoys at present almost a world monopoly of this important fertilizing product.

"In 1904, while borings were being made with the hope of striking oil in upper Alsace, kali salts were discovered. In 1909 the first kali mining shaft was completed in this district, and in 1910 37,000 tons and in 1911 45,000 tons of kali salts were extracted. Since then new mines and new shafts have been put in working order, so that at the end of 1912 in Alsace there were some 10 mines being exploited, all under the control of the German Kali Syndicate. Other mines are projected, and at the end of five years it is proposed to have 18 shafts in operation. The numerous borings already made seem to establish the fact that a vast deposit of kali exists covering an area of about 77 square miles.

"This deposit is in the region of the upper Rhine, between the towns of Mülhausen, Regisheim, Sennheim, and Ensisheim. There, in some remote geological age, a subterranean sea deposited its salts in the form of sylvite and other potash salts.

"This deposit occurs in two strata separated by a stratum of marl about 60 feet thick. They lie about 2,000 feet from the surface. A layer of rock salt about 500 feet thick is found between the soil and the potash. The upper layer has an average thickness of 3.818 feet. The lower layer has an average thickness of 13.847 feet, of which about 10 feet may be considered pure sylvite. The total deposit is estimated at about 1,472,000,000 tons.

"This salt averages 22 per cent pure potash, and is consequently considerably superior to the Stassfurt kali, which contains but 12.4 of pure potash. In terms of pure potash the Alsace deposit is calculated to contain 300,000,000 tons, which at present prices is worth $13,566,000,000. The layers of kali vary in color from brown to a rose color.

"Extensive factories for working the mineral, storehouses, railway tracks, and houses for the workmen are in process of construction, and a very important industry is growing up in the kali mining district. Colmar is to be a distributing center of potash salts for South Germany.

"According to a recent report the agricultural station at Colmar has been making investigations as to the composition of the products of the potash mines at Wittelsheim, Alsace. The station finds that different specimens of the native potassium salts of this region all have a similar composition, the only difference of importance being the difference in the proportion of potassium, which varies in the samples examined from 12.1 to 23.5 per cent. The soluble salts of magnesium and of lime, which are found in masses in the native kainite of North Germany, and also the soluble sulphates of potash, are of lesser importance in the Alsace kainite of Wittelsheim. The native potash of Wittelsheim consists rather of mixture of chlorides of potassium and sodium and resembles the sylvite salts of Galicia.

"The Alsatian salts show quite a variation in the amount of carbonate of lime. There is no doubt that this comes from the calcareous clay that is found in the Alsatian potash either because it can not be entirely eliminated or because it is added to the prepared salts in the form of a fine powder to make the Alsatian potash conform to the potash of other German mines."

See also Die Kalibergwerke im Oberelsass, Jahrsber. industriel. Gesellsch. von Mülhausen i. E., Julius Springer, Berlin, 1913.

TABLE I.—*Imports of potash salts for fiscal years ended June 30, 1912, and June 30, 1913.*

Salt.	Twelve months ended June 30, 1912.		Twelve months ended June 30, 1913.	
	Quantities.	Values.	Quantities.	Values.
	Tons.	*Dollars.*	*Tons.*	*Dollars.*
Muriate of potash	241,872	7,235,718	225,366	6,782,056
Sulphate of potash	49,813	1,826,836	47,874	1,753,485
Nitrate of potash (crude)	3,488	226,851	5,607	290,492
Kainit	485,132	2,399,761	466,795	2,154,977
Manure salts	192,738	1,814,071	171,802	1,794,058
Total	973,043	13,503,237	917,444	12,775,068

In Table I is given a statement of the imports of potash salts for the years ended June 30, 1912 and 1913, respectively. Except the nitrate, practically all the other salts come from Germany. Up to the year 1913 the imports of all these salts had been increasing, but in the year ended June 30, 1913, there was a decided falling off in the salts imported from Germany. The reasons for this decrease are probably complex. The preceding year was a late one, especially in the South Atlantic States, so there was a considerable decline in the purchase of fertilizers and consequently a holding over of a considerable portion of the manufactured goods. It is also claimed by some observers that the manufacturers of "mixed" or "complete" fertilizers are showing a tendency to put out goods with a lower content of potash, since probably there is less profit in the potash than in the other constituents.

DESIRABILITY OF AN AMERICAN SOURCE OF POTASH.

It is obviously undesirable that the United States should be dependent upon any other nation for its supply of a necessity. Over and above the political arguments usually advanced in this connection, the Stassfurt deposits, though they probably will have a long producing life, are not nevertheless inexhaustible. Furthermore, they are subject to vicissitudes which might at any time bring disaster to any nation which is largely dependent upon agriculture for its welfare and stability. From time to time and in spite of every care and precaution borings have become flooded, with the inevitable abandoning of the mine and permanent loss of the potash contents at least. In the past this has attracted considerably less attention than its importance deserves, because the general market was not much influenced and because often the particular management affected has sunk new shafts in the neighborhood and resumed operations. Within very recent time one of the mines has been flooded, with the result that overnight, as it were, 1 per cent or more of the world's visible supply of potash disappeared.[1]

[1] Jessenitz disaster.

AMERICAN INVESTIGATIONS.

Within the last few years some American importers of potash salts, endeavoring to develop trade arrangements of greater advantage to themselves than had hitherto prevailed, brought on a controversy with the Kali Syndikat, which in turn led to diplomatic exchanges between the Governments of the United States and Germany and attracted considerable attention in the public prints. Mainly in consequence of the attention and interest thus aroused, Congress authorized and directed that special investigations be promptly instituted to determine the possibility of obtaining potash salts of American origin on a commercial scale. These investigations by Federal officers have also stimulated private enterprise to a considerable extent, and the results of these several activities appear to be sufficient already to show that the commercial production of potash salts from American sources and in quantities sufficient to meet the growing needs of the Nation is quite practicable. The investigations in this direction are by no means completed; are, in fact, yet in their infancy, and what the ultimate possibilities of American potash may be can not yet be predicted with certainty. A number of possible sources of potash have been and are being actively investigated at the present time, and several publications describing recent activities in this direction are readily accessible.[1]

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THE GIANT KELPS.

There is a large number of algæ (seaweeds and rockweeds) growing on the Pacific coast. Occasionally specimens of these show a large content of potash, but three only seem to offer any particular promise of importance as possible commercial sources of potash salts, because in addition to having a high potash content they occur in large masses and grow in open water, and hence can be easily harvested. Other species or varieties, even if they contain a high percentage of potash, are not commercially available for one reason or another. For instance, *Pelagophycus porra* probably contains on the average more potash than any other kelp, but it occurs in scattered groups or single plants along the outer or seaward edge of Macrocystis beds in amounts too small to make it of any commercial importance in itself.

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Generally, the kelp beds are what are known as pure stands. Thus the large Macrocystis beds on the Lower California coast contain only occasional specimens of *Pelagophycus porra* along their outer edges. Farther north *Macrocystis pyrifera* and *Nereocystis luetkeana* grow in intermingled patches seemingly without any definite relations as to position. But there is no intermingling of individual plants of both species. Nereocystis and *Alaria fistulosa* grow together, but always the Nereocystis is found outside of the Alaria.

The principal conditions for growth and the possibility of occurrence are the same for any of the giant kelps. There must be a rocky bottom to furnish anchorages to which the holdfasts may be attached, and there must be a considerable movement of the water with continuously renewed supplies. The reason for the first condition is obvious; the second requires explanation. The kelps are chlorophyllous plants of relatively large bulk, and require in the aggregate a large quantity of carbon dioxide to build up their organic tissues. Being submerged, they can obtain it only from the supply dissolved in the sea water. Since the solubility of carbon dioxide in sea water is quite small, there must be a large volume of sea water brought into contact with the plants. Hence the kelps are found where there is a continued swell on the open-sea coast or in rapid tideways.

While the different kelps vary quite widely one from another in general appearance and in certain peculiar characteristics, roughly speaking, they are much alike in their makeup. They all have a *holdfast* (Pl. I), a group of tentacle-like branches much resembling in appearance the roots of a land plant. The function of the holdfast is to grow about a rock or other relatively immovable inert substance, sometimes even another kelp plant, and thus anchor the growing plant. From the holdfast toward the surface extends the *stipe* or stem, terminating in the *pneumatocyst* or float, a hollow organ of thick, fleshy walls, filled with air and thus remaining on the surface of the sea. From the pneumatocyst extend the fronds or leaves. The tissues of the kelp contain little or no fiber, are easily crushed to a pulpy mass, and in this condition more or less readily pass through ordinary filtering septa.

MACROCYSTIS PYRIFERA.

Macrocystis pyrifera has been reported as growing as far north as Sitka.[1] But it is of no great importance north of Point Sur. Below Point Sur, however, it predominates almost to the exclusion of other species. It there occurs in large beds or groves, sometimes several

[1] According to Darwin (The Voyage of the *Beagle*, Harvard Classics, p. 255) it is found on the eastern coast of South America from the extreme southern islands near Cape Horn to latitude 43° S. On the western coast it is to be found throughout its extent. Darwin quotes Capt. Cook and others to show the "immense range" of its distribution on Pacific shores.

miles in length and varying from 50 to 100 yards up to 2 or more miles in width. Macrocystis is usually found on exposed coasts where there is a continual swell. At 3 fathoms or less it grows in small patches, but the larger groves or beds are usually at 6 fathoms on the landward side to 10 fathoms or more on the seaward side. As noted above, along the outer edges of the Macrocystis beds at from 8 to 14 fathoms will often be found plants of *Pelagophycus porra.*

From the holdfast of the Macrocystis spring a number of stipes, each stipe bearing at intervals along its entire length a series of fronds or leaves, each having at its base a small pneumatocyst. The leaf averages between 12 and 14 inches in length and 3 or 4 inches in width at its widest part, and is serrated. The pneumatocyst is roughly pear shaped, about 2 inches in length and something less than an inch at widest cross section. The stipe is usually from 90 to 100 feet in length, although much greater lengths are common, and even a length of 1,000 feet has been reported.

Macrocystis is probably perennial, and has a life history certainly longer than a year. It grows from spores, which develop usually on leaves at a considerable depth below the surface of the water. Consequently the cutting of the Macrocystis beds to a moderate depth (2 fathoms or less) would not be at all likely to impair the stand.

It is popularly supposed that when a Macrocystis stipe is cut or otherwise severed it continues to grow quite rapidly. It has been said that beds where the surface kelp has been damaged or destroyed are restored to their previous luxuriance in from 40 to 60 days. But the careful observations of Crandall and Michael appear to show clearly that when the stipe is cut decay sets in at the injured surface and progresses more or less slowly toward the holdfast. At the same time, however, because of the mechanical stimulation or for some other reason, new stipes are sent out from the holdfast or branching of existing stipes is induced. The resultant effect is similar to the well-known "stooling" of wheat. Observations on cut-over areas near Point Loma and Point Fermin showed a much heavier growth a year later. It is altogether probable that the Macrocystis beds can be successfully harvested twice or oftener in a year without danger to the continued growth of the beds.

Considering only analyses made in the laboratories of the Bureau of Soils, 58 samples of Macrocystis in all have been analyzed. Including all the analyses they average for samples dried in the oven at 105° C.:

	Per cent.
Total soluble salts	30.00
K_2O	12.59
I	.23
N	1.57
Ash	5.9

It is probable that these figures for potash and nitrogen are somewhat too low. The variations were from 3.10 per cent to 27.66 per cent for potash and 0.53 per cent to 3.17 per cent for nitrogen.[1]

NEREOCYSTIS LUETKEANA.

Nereocystis is apparently an annual. At least it appears to die out in the fall and grows anew in the spring. Recently, however, mature plants have been found early in the summer, which could be only holdovers or survivals from the crop of the previous year. The plant consists of a holdfast (Plate II) from which stretches a long stipe (Plate III), averaging perhaps 40 feet, although both

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[1] The methods used in making analyses of kelp are as follows: The samples, when received at the laboratory in Washington, D. C., are either wet or air dried. When wet they are contained in glass jars with air-tight stoppers, while the dry samples are in cloth bags. The wet samples are transferred in entirety to large porcelain dishes, the jars washed several times in water, the washings being added to the samples. The samples are then heated over the steam bath, and finally put in the drying oven for at least 12 hours at a temperature of 105° C.

The whole dry samples as received are also put into porcelain dishes, care being taken to lose none of the effloresced salts adhering to the interior of the bag. The sample is then put in the drying oven and kept there for at least 12 hours at 105° C. The whole oven-dried sample as obtained by either of the above procedures is ground in an iron mortar to the fineness necessary for sampling for analysis. It is impossible to take subsamples representative of the whole sample of kelp as received unless the entire sample is dried and ground as above, for two reasons—first, because of the unequal distribution of the constituents sought in leaves and stem of the plant; second, because of the efflorescence, which is not evenly distributed through the mass of unground kelp.

Samples of 0.5 gram are weighed directly into tared platinum dishes. These dishes are then placed in an electrically heated furnace and heated to below dull redness, thus causing destructive distillation to take place. The gases evolved are ignited. The dishes are then allowed to remain three to four hours at the same low temperature. The charcoal is almost completely burned off at the end of this time, leaving a grayish to white, loose, powdery mass. This is transferred to a 200 cubic centimeter beaker, the portions adhering to the dish being washed into the beaker by means of water and a "policeman." The volume of water is brought to about 50 cubic centimeters and then evaporated down to about 10 to 15 cubic centimeters. The solution thus obtained is filtered into a platinum dish, the grayish-white ash being thoroughly washed with hot water.

To this filtrate is added a few cubic centimeters of ammonium carbonate solution, in order to precipitate calcium carbonate, and it is then evaporated to dryness. The ammonium salts are expelled by heating briefly to dull redness. Hot water is added and the solution filtered into a weighed platinum dish. Hydrochloric acid is added and the solution evaporated to dryness. The dry salts are heated briefly to dull redness again, cooled in a desiccator, and the weight recorded as "soluble salts." The soluble salts are then dissolved in water, transferred to graduated flasks, and aliquot portions taken for potassium determinations by the chlorplatinate method. The residue on the filter from the first filtration, together with the precipitate caught by the second filtration, are ignited to whiteness and the weight of the material obtained is recorded as "ash."

The nitrogen determinations are made by the Kjeldahl method on subsamples of the ground, oven-dried material. Mr. T. C. Trescot, of the Bureau of Chemistry, has been kind enough to make most of these for us.

For the determination of iodine, 2 grams of ground material are incinerated and lixiviated. The solution thus obtained is evaporated to a volume and transferred to a separatory funnel of 250 cubic centimeters; 10 cubic centimeters of a solution of sulphuric acid (1 c. c. conc. H_2SO_4, 9 c. c. H_2O) and 10 cubic centimeters carbon tetrachloride are then added. The solution is titrated with a potassium permanganate solution previously standardized against pure potassium iodide, using the same manipulation in this standardization as with the actual analysis. The free iodine is removed as fast as formed in the solution by shaking with the carbon tetrachloride. The end point is reached when the pink color persists in the solution.

longer and shorter lengths are common. The stipe terminates in an almost spherical-shaped pneumatocyst or float, some 7 or 8 inches in external diameter, with fleshy walls something less than an inch in thickness. (Plate IV.) From the float opposite the stipe termination there springs in the young plant a leaf which, as the plant matures, separates into a number of long, stringlike leaves. (Plate V.) Nereocystis grows in open water, but is even more commonly found in rapid tideways. It propagates by spores formed in spots or sori on the leaves. These spores ripen by midsummer. Plates VI and VII show young plants of this species.

Because Nereocystis is an annual, it is apparent that some precautions must be taken in order that harvesting may not permanently deplete or destroy the beds. Obviously, it would be wiser not to harvest earlier than the fruiting period. In the Puget Sound region it would probably be unwise to harvest earlier than July 15, and a postponement of the date for two weeks is to be preferred. In Alaska the earliest date that can be wisely set is probably August.

In the event that it should be found desirable or necessary to harvest at earlier dates than those just suggested, care should be taken to leave in every bed sufficient plants to yield at least fruiting spores enough to insure the reseeding of the bed. This plan is by no means difficult to follow, since any plan for harvesting on a commercial scale could hardly result in cutting every plant from a bed, but it would probably be wiser to leave uncut strips or patches at intervals throughout the beds. Possibly it may become necessary to impose some policing or governmental control of the harvesting, but it does not seem wise to suggest any legislation to this end until the factors and problems involved have received further study under conditions of actual exploitation of the beds.

In the laboratory of the Bureau of Soils 51 samples of Nereocystis have been analyzed. Rejecting none, they average on samples dried in the oven at 105° C. as follows:

	Per cent.
Total soluble salts	46.9
K_2O	20.1
I	.13
N	1.9
Ash	4.2

The variation of the potash content of these samples is from 6.58 per cent to 31.62 per cent, while the corresponding variation for nitrogen is from 0.81 per cent to 3.06 per cent. Inspection of the several analyses indicates that the above averages fairly represent the salt contents of this plant. In content both of potash and nitrogen Nereocystis runs higher than Macrocystis.

ALARIA FISTULOSA.

Alaria is a perennial and is found in the tideways of the Alaskan coast, usually at somewhat shallower depths than Nereocystis, especially so when the two growths are contiguous. (Pl. VIII.) It requires, apparently, a greater renewal of water than is absolutely essential to Nereocystis. But, on the other hand, it can not grow in the rougher waters where Nereocystis flourishes. It has a holdfast quite similar to those of other kelps, from which springs a stipe about 8 inches in length, at the extremity of which grows a bunch of relatively small leaves which are the spore producers. From this bunch extends a long, rather fragile leaf averaging perhaps 40 feet in length, with an average width of less than 20 inches, though wider plants are fairly common, and extreme widths of upward of 5 feet have been found. Throughout the length of this leaf extends a hollow, flattened midrib perhaps an inch in diameter, with nodes at intervals of a few inches, at which points the tube is closed in such fashion that the whole midrib is a series of floats. (Pls. IX, X, XI.) The outer extremity is more or less torn, and in fact the local name for this plant is the "stringy kelp." The region of growth is the lower extremity of the leaf, so that it can obviously be harvested even to considerable depths without serious detriment to the stand, especially since the spore production is on the small, branchy leaves at the base of the long predominating leaf.

Of *Alaria fistulosa* but 15 analyses by the Bureau of Soils are available. The averages on samples dried in the oven at 105° C. are as follows:

	Per cent.
Total soluble salts	24.4
K_2O	9.1
I	Trace.
N	2.6
Ash	7.5

Inspection of the several analyses indicates that this average figure for potash is too low. The variation in content of potash of these 15 samples is from 2.9 per cent to 13.1 per cent. The variation in per cent of nitrogen is from 2.1 to 3.3.

KELP AS A FERTILIZER.

For hundreds of years kelp and seaweed have been recognized as valuable fertilizers. On the shores of Scandinavia, Brittany, and the British Isles they have long been so used, and recently attention has been directed to this use by a British official publication.[1] On

[1] Leaflet No. 254, Board of Agriculture and Fisheries (1911). See also Wheeler and Hartwell, Bul. No. 21, Rhode Island State Expt. Sta., 1893; also Consular Report by John L. Griffiths, quoted in Commercial Fertilizer, Vol. VIII, July, 1914, pp. 54–58.

the New England coast kelp day is a local holiday of note, to which attention has been often called. Coming in the fall, after the harvest time and also at a season usually preceded by stormy weather, great quantities of the local seaweeds are commonly strewn along the beach, which are gathered and hauled to the farms, sometimes quite a distance inland. The giant kelps of Alaska have been used to a quite considerable extent, especially on land planted to potatoes, and it appears that this use of the green kelp is no small or unimportant feature of the agriculture at many points on the Alaskan coast. Plates XII, XIII, XIV show some potatoes thriving on what might fairly be expected to prove almost barren sands were it not for the liberal use of fresh kelp on the soil.

From these considerations it is to be expected that the air-dried or oven-dried kelp would prove a satisfactory fertilizer, especially on soils known to respond favorably to applications of potash salts. This has actually been shown to be the case in an experimental comparison of dried kelp with ordinary potash salts[1] by growing wheat in pot cultures, where the soil in the several pots had been treated with equivalent amounts of potassium in the form of sulphate, chloride, and dried kelp, respectively. Balch considered that kelp parched or partially charred at a temperature of 200° C. to 240° C. would be better adapted to use as a fertilizer than the kelp dried at ordinary temperatures. This parched kelp he called saline humus, and in patent No. 771760, dated 1904, he described it as follows:

> The material in this state, i. e., parched and ground, can be marketed per se, as a very cheap and efficient fertilizer, being rich in potassium salts and containing calcium and magnesium, both as phosphates and in combination with organic acids. The material also contains nitrogenous substances, which, as they decompose, yield ammonia and other compounds of nitrogen to the soil. It is also possible to mix this product with the various substances required by certain crops in the manufacture of a number of special fertilizers.

Kelp simply dried but not parched is readily pulverized to a substance of ideal mechanical properties for use in compounding mixed fertilizers. It readily decomposes in the soil. Samples prepared in the laboratory on a several-pound scale contain ordinarily about 15 per cent potash, 2 per cent nitrogen, and 1.5 per cent phosphoric acid. Taking everything into consideration—cost of production, cost of handling, and properties which will appeal to the manufacturer of mixed goods—dried powdered kelp is the product which seems to offer the best possibilities for quickly finding a substantial commercial demand.

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[1] Skinner and Jackson, Circ. No. 76, Bureau of Soils, U. S. Dept. of Agr., 1913.

HARVESTING OF KELP.

Numerous devices have been proposed for harvesting kelp and several have been tried out experimentally. The greater number of these devices employ the well-known principle of the hay mower to be found on nearly every farm. A successful machine of this type has been operated over the kelp beds near Point Fermin. Figure 1 shows drawings from which a machine was built. The operation of this machine will be plain from the accompanying photographs. Over one end of a flat-decked barge extends an endless belt about 10 feet wide, made by stretching a coarse fish net over chains. (See Pl. XV.) The endless belt extends below the surface of the water to a depth of about 4 feet. At the submerged end is a horizontal scythe blade, at either end of which is a perpendicular blade. Through appropriate gears these blades are given a cutting motion with a stroke of about 4 inches by a gas engine mounted on the barge. The launch pushes the barge through the kelp bed at a pace of about 4 miles an hour. The cut kelp falling on the endless belt is brought over the side and falls into a hopper (Pl. XVI) through a set of revolving knives similar in design to the ordinary lawn mower, where the kelp is cut into pieces about 6 inches in length. From this chopper the kelp is then conveyed to an undecked barge (Pls. XVII to XIX, inclusive) to be towed ashore and landed at the factory. (Pl. XX.) The operation of this harvester requires four men, one on the launch, and a second to watch the cutting and to ward off with a boat hook logs and other undesirable materials which may be floating amongst the kelp. A third man attends to the loading of the kelp on the towed barge, while the fourth man looks after the engine and running gear. This cutter, running intermittently for about a year, harvested something less than 3,000 tons. Its operation is a very impressive and convincing sight. (Pl. XXI.) Its capacity (if run steadily) in medium or heavy kelp beds would be probably over 25 tons of fresh kelp an hour.

To estimate the cost of harvesting kelp is a difficult matter. Existing data are very limited. Definite figures for operations sufficiently extensive to give the figures any real significance have thus far been obtained for only one locality and one equipment. Kelp has been cut on the Point Fermin beds and landed at San Pedro for less than 20 cents a ton. With improved apparatus, avoiding the shortcomings which have developed in the present crude, pioneer devices, and with trained crews, this cost or better can probably be realized at any point at which kelp harvesting is really a practicable industry.[1]

[1] For a discussion of the cost of producing and marketing dry kelp the reader is referred to the Journal of the Franklin Institute, Vol. CLXXVI, p. 347 et seq., 1913.

U. S. DEPT. OF AGRICULTURE
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MILTON WHITNEY, CHIEF

KELP MAP

PACIFIC COAST - ALASKA

SHEET A

FERTILIZER INVESTIGATIONS
FRANK K. CAMERON in charge
Mapped by Geo. B. Rigg

U.S. DEPT. OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY, CHIEF
KELP MAP
PACIFIC COAST - ALASKA
SHEET B
MAP SHOWING LOCATION AND EXTENT OF
KELP GROVES
ALASKA SOUTH COAST
RESURRECTION BAY TO COOK INLET
AND
(INSERT) KUIUKTA BAY TO UNGA ISLAND
ALASKA PENINSULA
COMPILED AND PUBLISHED BY THE BUREAU OF SOILS
U.S. DEPARTMENT OF AGRICULTURE
From U.S. Coast and Geodetic Survey Charts and other Surveys
Statute Miles
Nautical Miles
Kilometers
NOT INTENDED FOR NAVIGATION
SOUNDINGS IN FATHOMS
AT MEAN LOWER LOW WATER
LEGEND
Thin
Medium Heavy
Very Thin
Heavy
Medium
COOK INLET
KACHEMAK BAY
KENAI PENINSULA
GULF OF ALASKA
Anchor Pt.
Bluff Pt.
Coal Bay
Port Graham
Pt. Adam
PORT CHATHAM
Cape Elizabeth
Elizabeth I.
CHUGACH ISLANDS
Pearl I.
PORT DICK
Pt. Gore
NUKA BAY
PYE IS.
McArthur Pass
AIALIK BAY
Rugged I.
Cape Resurrection
BLYING SOUND
RESURRECTION BAY
SEWARD
ALASKA PENINSULA
KUIUKTA BAY
TO UNGA ISLAND
BEAVER BAY
UNGA STRAIT
C. Aliaksin
C. Swedania
UNGA I.
POPOF I.
POPOF STRAIT
Unga Cape
High I.
KOROVIN I.
Karpa I.
Gorman Strait
Andronica I.
STEPOVAK BAY
FOX BAY
Dome Pt.
Boulder B.
Bluff Pt.
IVANOF BAY
Jacob I.
Paul I.
Chiachi I.
Pinusuk I.
MITROFANIA BAY
Mitrofania I.
PACIFIC OCEAN

PREPARATION OF PURE POTASSIUM CHLORIDE.

The salts contained in kelp are mainly potassium and sodium chlorides. To a small extent calcium and magnesium salts and iodides are present and probably unimportant amounts of other salts. While the ratio of potassium chloride to sodium chloride varies more or less, for general argument it may be assumed as approximately 3 to 2. The separation of these salts from the organic residue has up to the present proved difficult. The salt which "effloresces" on the surface of kelp slowly dried can be to a large extent shaken or sifted off, but the separation is a very crude and unsatisfactory one. The water present in freshly cut kelp is more than sufficient to dissolve all the salts present, but filtration methods have not hitherto been successful, because the absence of fiber permits much of the organic material to pass through the filter medium and the latter is generally soon clogged.

Diffusion methods have been tried on a small scale, but have not given any great promise of commercial adaptation, although their success in the sugar industry would warrant further experimentation.

Experiments now in progress indicate that a way will ultimately be found by which the crushed kelp can be so treated that the organic tissues will be coagulated and filtration thus become practicable.

The further separation of the potassium chloride from the sodium chloride is a comparatively simple operation. It is best accomplished by crystallizing first at one temperature and then another. The "constant solutions" for this pair of salts at various temperatures have been determined by Precht and Witt.[1] Using round numbers as sufficiently accurate for present purposes, the composition of the solutions is:

At 100° C.	100 H_2O	35 KCl	26 NaCl
At 25° C.	100 H_2O	16 KCl	29 NaCl

Suppose, therefore, the filtrate from the coagulated kelp were evaporated at 100° C. until the concentration of potassium chloride reached 35 parts KCl to 100 parts H_2O. Cooling to 25° C. would be accompanied by the precipitation of 19 out of the 35 parts of practically pure potassium chloride. Adding fresh filtrate to the mother liquor and again evaporating at 100° until the ratio 35 KCl to 100 H_2O was reached, some sodium chloride would be precipitated practically pure. Decanting and cooling, a second crop of potassium chloride would be obtained. Alternate crystallizations, therefore, first in a hot vat and then in a cool, more filtrate being added to the hot vat each time, would result in the accumulation of practically pure potassium chloride in the cool vat and sodium chloride in the

[1] Ber., 14, 1667 (1881).

hot vat. Pumping from one vat to another should be a simple and comparatively inexpensive operation. Meanwhile the mother liquor from these crystallizations would become concentrated with respect to iodides and might conceivably be treated with profit for the recovery of iodine.

Apparently the recovery of pure potassium chloride with the incidental preparation of cattle food (containing 4.5 per cent nitrogen), pure sodium chloride, and potassium iodide, would be more profitable than the preparation of ground, dried kelp. This is not certain, however, partly because the preparation of the pure potassium chloride would require careful chemical control, and in consequence more skillful labor and higher overhead charges.

LEACHING OF KELP IN SEA WATER.

Drift kelp has usually a low content of potash, and from this fact it is currently believed that freshly cut kelp would soon lose the major part of its content of potassium chloride if allowed to remain immersed, the loss being replaced in part at least by sodium chloride from the sea water. To test this point, possibly of considerable importance when harvesting on any large scale, a number of experiments were carried on during the months April to October, 1913. Large samples of Macrocystis were collected by W. C. Crandall. These were towed in sea water, and from time to time subsamples were withdrawn from the water and forwarded to the laboratory of the Bureau of Soils at Washington, where they were analyzed, the nitrogen determinations being made by Mr. T. C. Trescot, of the Bureau of Chemistry. The results are given in Tables II, III, IV, V, VI, and VII.

TABLE II.—*Leaching of kelp in sea water.*

[Sample taken near Coronado Islands.]

Time exposed.	K_2O.	N.	Soluble salts.	Remarks.
Hours.	*Per cent.*	*Per cent.*	*Per cent.*	
None.[1]	12.48	0.98	31.46	Dried and sent by mail.
None.[1]	13.47	.79	31.26	Wet, sent in jar by express.
None.[1]	18.28	.51	36.78	Stems only, dried and sent by mail.
None.[1]	9.90	.84	25.94	Leaves only, dried and sent by mail.
3	15.56	.95	34.00	
6	17.30	1.00	38.26	
14	17.64	1.07	38.30	Wet, sent in jar by express.
17	13.35	.83	31.96	
20	10.74	.90	26.36	

[1] Fresh cut.

Analyses by A. R. Merz and J. R. Lindemuth.

TABLE III.—*Leaching of kelp in sea water.*

[Sample taken near Point Loma.]

Time exposed.	K_2O.	N.	Soluble salts.	Remarks.
Hours.	*Per cent.*	*Per cent.*	*Per cent.*	
None.	15.82	2.77	40.88	
3½	13.43	2.66	34.82	
15½	14.96	2.40	37.66	
18½	13.05	1.77	34.34	
21½	11.00	1.85	30.22	
24½	11.59	2.10	30.52	
27½	13.68	2.22	38.94	
39½	10.31	1.97	27.84	
42½	16.39	2.22	38.78	
45½	11.77	1.99	32.44	
48½	16.69	1.79	39.72	
51½	15.77	2.29	40.80	Wet, sent in jar.
63½	16.74	2.49	42.58	
66½	16.75	1.91	38.64	
72½	14.67	1.88	35.58	
75½	12.61	2.66	34.74	
87½	15.54	2.47	40.84	
90½	17.62	2.16	41.42	
93½	17.03	2.28	42.44	
96½	15.61	2.16	37.80	
99½	20.28	2.12	46.28	
111½	15.72	2.26	38.80	
111½	15.27	1.80	34.52	Dried and sent by mail.
135½	15.60	2.57	39.24	Wet, sent in jar.

Analyses by A. R. Merz and J. R. Lindemuth.

TABLE IV.—*Leaching of kelp in sea water.*

[Sample collected near Point Vincente.]

Time exposed.	K_2O.	N.	Soluble salts.	Remarks.
Hours.	*Per cent.*	*Per cent.*	*Per cent.*	
None.	10.47	1.79	54.54	Wet, in jar.
None.	10.09	.53	26.34	Dried, in sack.
3	17.61	1.26	39.50	Wet, in jar.
4	14.81	1.94	35.28	
6	13.01	.70	32.14	
8	13.29	.90	31.74	
15	14.32	.80	32.90	
20	16.55	1.57	35.86	
26	13.39	.70	30.26	
30	16.67	1.60	37.26	
34	12.67	1.07	29.44	
38	10.61	.86	30.14	
53	12.33	1.01	29.46	
56	11.64	1.07	31.18	
59	11.87	.89	30.64	
62	12.85	1.11	32.36	
65	13.76	.83	33.48	
77	13.73	1.00	32.72	
101	14.16	1.40	34.62	
125	14.72	.97	33.76	
149	10.24	1.54	29.44	
173	14.19	1.55	32.98	

Analyses by A. R. Merz.

TABLE V.—*Leaching of kelp in sea water.*

[Sample taken near Point Loma.]

Time exposed.	K_2O.	N.	Soluble salts.	Remarks.
Hours.	*Per cent.*	*Per cent.*	*Per cent.*	
None.	11.52	0.84	27.48	Wet, sent in jar by express.
None.	14.66	.96	32.91	Dried, sent in bag by mail.
3	11.42	.92	29.34	Wet, sent in jar by express.
4	14.44	1.09	31.72	
5	14.47	.65	33.42	
6	17.45	1.62	[1] 39.74	Wet, sent in jar.
7	14.37	1.84	[1] 33.94	
8	14.50	1.24	33.76	
9	16.33	1.31	38.34	
10	14.29	1.01	31.02	
11	16.49	1.47	39.48	
12	12.58	1.21	33.86	
20	17.45	1.53	[1] 38.62	
21	15.87	1.68	37.50	
22	13.36	1.04	32.50	
23	14.96	1.42	35.58	
24	13.13	1.25	31.94	
27	16.24	1.04	37.70	
30	12.24	1.62	30.46	
33	14.37	1.54	33.62	
36	12.74	1.52	30.16	
42	8.51	1.04	24.78	
45	9.10	1.01	26.80	
48	11.27	1.21	28.16	
51	17.58	1.51	39.66	
54	13.42	.90	30.84	
57	12.32	1.67	[1] 31.90	
66	11.61	1.18	30.16	
72	14.78	1.21	35.34	
78	11.49	.97	30.60	
90	14.16	.92	35.90	
96	12.95	1.73	31.38	
120	12.01	1.49	32.08	
144	10.83	1.52	28.66	

[1] Subsample was decayed.

Analyses by A. R. Merz.

TABLE VI.—*Leaching of kelp in sea water.*

[Sample taken near Coronado Islands.]

Time exposed.	K_2O.	N.	Soluble salts.	Remarks.
Hours.	*Per cent.*	*Per cent.*	*Per cent.*	
None.	16.67	1.32	37.84	Dried, sent in bag.
None.	13.94	.58	32.68	Wet, sent in jar.
4½	13.69	1.09	31.30	
5½	13.50	1.40	34.08	
6½	15.78	1.38	36.28	
7½	18.26	1.63	[1] 41.54	
8½	11.87	.92	29.16	
9½	14.32	.95	34.14	
10½	16.80	.98	37.56	
11½	11.21	.66	27.64	
12½	16.52	.87	36.94	
13½	15.00	1.09	35.84	
21½	12.95	.86	31.98	
22½	17.36	1.05	39.28	
23½	16.74	.73	38.08	
24½	16.46	.66	37.28	
25½	17.11	.92	39.44	
28½	15.03	.87	35.82	
31½	16.86	.86	38.10	
34½	17.88	1.01	40.10	
37½	16.77	.84	37.88	
43½	16.70	1.01	40.02	
46½	13.28	.76	32.10	
49½	14.01	.76	35.78	
52½	14.37	.72	34.68	
55½	9.91	.99	27.22	
58½	16.43	.98	37.36	
67½	13.91	.90	31.92	
73½	13.54	.72	32.02	
79½	17.33	.95	38.12	
85½	13.07	.83	37.38	
91½	16.46	1.01	37.62	
97½	16.52	.93	37.14	
121½	17.11	1.20	39.04	
145½	15.06	.78	35.60	

[1] Subsample was decayed.

Analyses by A. R. Merz.

TABLE VII.—*Average analyses of samples of leaching experiments.*

Table.	K_2O.	N.	Soluble salts.	Period of experiment.
	Per cent.	*Per cent.*	*Per cent.*	
II	14.30	0.87	32.70	Apr. 16–17.
III	14.91	2.20	37.49	Apr. 18–24.
IV	13.32	1.14	33.46	Aug. 9–17.
V	13.62	1.27	32.91	Sept. 27–Oct. 3.
VI	15.21	.95	35.68	Sept. 27–Oct. 3.

The data given in these tables show that it is difficult to obtain samples truly representative of the whole plant. But, so far as can be judged, there is no appreciable loss of potash or nitrogen when the kelp is immersed for periods as long as eight consecutive days. It is not, apparently, until the actual death of the plant and consequent degradation or decomposition of the cell tissues that the loss of potash begins to be appreciable.

DISTRIBUTION OF CONSTITUENTS IN KELP.

A comparison of the potash and other constituents occurring in leaves and stipes, respectively, is given in Table VIII.

TABLE VIII.—*Comparative analyses of leaves and stems of kelp.*

Sample.	K_2O.	N.	Ash.	Total soluble salts.	Remarks.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	
Nereocystis, stems	24.26	1.38	3.91	53.78	Average of 17 samples.
Nereocystis, leaves	16.38	2.31	4.52	40.98	Average of 21 samples.
Macrocystis, stems	16.59	1.04	4.61	37.17	Average of 3 samples.
Macrocystis, leaves	10.86	1.64	3.89	27.13	Average of 2 samples.
Postelsia palmaeformis, stems	21.40	.98	3.60	42.60	Do.
Postelsia palmaeformis, leaves	11.80	1.62	5.00	29.80	Do.

Determinations of this character have not been made for Alaria, but these would have no importance for the commercial exploitation of this kelp, as it would never be harvested at a depth to involve the stipes. It is of course quite possible that the presence of stipes in the harvested Alaria would appreciably increase the potash content of the harvested material, since the data in the table show pretty conclusively that a greater content of potash may generally be expected in stipes than in leaves. Per contra, as might be expected, the nitrogen content of leaves is generally higher than that of stipes. The same is true of the ash, while the greater content of soluble salts is in the stipes.

In Tables IX and X are given data showing the comparison between leaves and stipes for individual plants which confirm the conclusions drawn from the averages given in Table VIII.

TABLE IX.—*Analyses of the stipe and fronds of Nereocystis.*

Sample and date collected.	K_2O.	N.	Ash.	Soluble salts.	Location.
	P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	
Fronds, June 5, 1913	16.95	2.44	5.02	40.68	West Point, Seattle, Wash.
Stipe, June 5, 1913	25.53	1.49	3.90	52.46	Do.
Fronds, June 26, 1913	18.42	2.81	5.00	43.46	Friday Harbor, San Juan County, Wash.
Stipe, June 26, 1913	6.58	3.25	6.10	14.66	Do.
Fronds, July 8, 1913	15.03	2.58	4.04	36.66	Do.
Stipe, July 8, 1913	25.34	1.28	2.76	55.66	Do.
Fronds, July 26, 1913	14.41	2.18	3.14	33.74	Do.
Stipe, July 26, 1913	28.50	1.21	2.84	56.40	Do.
Fronds, Aug. 14, 1913	11.49	2.70	4.54	31.10	Near West Point, Seattle, Wash.
Stipe, Aug. 14, 1913	22.29	1.60	4.04	44.40	Do.

Analyses by A. R. Merz. Samples collected by Ethel M. Bardell.

NOTE.—Sample of stipe collected June 26 appeared to have been dead when cut, judging from the condition of sample when received, and analysis strengthens this supposition.

TABLE X.—*Comparative analyses of leaves and stems of different species of kelp.*

Sample.	K_2O.	N.	Ash.	Soluble salts.	Location.
	P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	
Macrocystis, leaves	9.90	0.84	3.88	36.78	Coronado Islands, Lower California.
Macrocystis, stems	18.28	.51	2.36	25.94	Do.
Nereocystis, leaves	15.44	2.27	4.34	39.40	Geese Islands, Alaska.
Nereocystis, stems	28.26	1.06	3.60	52.88	Do.
Nereocystis, leaves	14.78	2.02	4.30	38.44	Port Graham, Alaska.
Nereocystis, stems	24.69	1.15	3.10	56.40	Do.
Nereocystis, leaves	12.74	2.87	5.12	34.38	Pearse Canal, Alaska.
Nereocystis, stems	23.88	1.53	10.66	49.44	Do.
Nereocystis, leaves	15.12	3.06	4.34	40.10	Between Tongass and Kanagunut Islands, Alaska.
Nereocystis, stems	30.12	1.07	2.76	63.74	Do.
Nereocystis, leaves	19.63	1.04	3.46	47.26	Gulf of Esquibel, Alaska.
Nereocystis, stems	27.02	.81	3.22	58.86	Do.
Nereocystis, leaves	16.74	1.52	5.66	42.74	Eagle Island, Davidson Inlet, Alaska.
Nereocystis, stems	28.76	.59	2.90	64.44	Do.
Nereocystis, leaves	17.67	2.01	4.98	44.40	Wrangell Island, Alaska.
Nereocystis, stems	24.80	.98	3.68	53.54	Do.
Postelsia, leaves	13.9	1.83	5.7	29.9	Neah Bay, Washington.
Postelsia, stems	20.0	1.01	4.0	41.1	Do.
Postelsia, leaves	9.7	1.40	4.3	29.7	Point Montara, California.
Postelsia, stems	22.8	.94	3.2	44.5	Do.
Macrocystis, stems and leaves	12.4	1.04	6.9	28.3	San Nicolas, California.
Macrocystis, stems	18.7	1.24	5.3	40.3	Do.

Analyses by J. W. Turrentine and A. R. Merz.

Comparisons between plants at different stages of growth or age are difficult because of insufficient data. In Table IX, giving data for Nereocystis collected at intervals from June 5 until August 14, it would appear that the potash content of leaves tends to decrease, while that of stipe does not, with age. However, the differences are no greater than found in subsamples of material gathered at any one time, and nothing further than a tentative conclusion is justified. From the data given for the leaching experiments on Macrocystis, it appears that the averages for potash content at different seasons show no characteristic or systematic variations. These averages have been brought together in Table VII.

THE DRYING OF KELP.

When kelp is dried slowly, there appears on the surface an efflorescence which can more or less readily be shaken off. This efflorescence is a mixture of potassium and sodium chlorides, the former predominating, together with smaller and generally negligible quantities of other salts. When, on the other hand, the drying is done quickly, this efflorescence is absent, or nearly so, the soluble salts being retained within the mass as a whole.

Freshly cut kelp contains variable amounts of water, from 80 to 90 per cent, a fair average being probably somewhat nearer the latter figure. This amount of water is more than sufficient to dissolve all the salts contained in the kelp. To handle the kelp as a commercial product it is necessary to reduce the water content to a small percentage,

and to do this by ordinary air drying will undoubtedly prove impracticable except under extraordinary conditions, as on the Mexican coast, where it is reported this procedure is now being followed on a rather extensive scale. In less favorable localities artificial drying must be employed. Of the various types of driers now used in industrial operations the rotating drum or tube seems best adapted to the kelp problem. The fresh kelp entering at the upper end of the tube or drum issues dry at the lower end to fall on a conveyor. Through the drum is passed a current or draft of air, preheated, which takes up the moisture from the kelp which is continually falling through it as the tube rotates.

There is no sufficient experience as yet from which to make satisfactory estimates of the cost of drying kelp. Laboratory experience indicates that it would be much more readily dried than garbage tankage, fish scrap, and even brines, all of which have been efficiently and economically desiccated in driers of this type.

MARKET FOR KELP.

At the present time comparatively little fertilizer of any kind is used on the Pacific coast. Its use is, however, increasing steadily, and with this increase will come, undoubtedly, a local appreciation of the value of kelp. There is also a noticeable prejudice, in California especially, in favor of the use of potassium sulphate rather than potassium chloride, the potash salt in the giant kelps. The conversion of potassium chloride to potassium sulphate is a comparatively simple operation. Sulphuric acid plants are now operating on the Pacific coast, and a salable by-product, hydrochloric acid, would also be produced by the treatment of potassium chloride or kelp with sulphuric acid.[1]

It is, however, to the maker of "mixed goods" and in other localities that kelp must look for an outlet at the present time. The Eastern seaboard States and especially the South Atlantic States are the great consumers of commercial fertilizers, and incidentally of potassium salts. According to the census estimates the South Atlantic States consumed, in 1909, 66 per cent of the entire production of commercial fertilizers, and many experts regard the present percentage of consumption to be far higher. As pointed out above, dried powdered kelp is admirably adapted to use in making mixed fertilizers,

[1] This appears to be an appropriate place to call attention to the possibility of producing potassium chlorate by electrolysis of the potassium chloride of kelp. The chlorate is a substance of fundamental importance in the manufacture of safety matches and certain types of "safety" explosives much favored by constructors on the Pacific coast, and potassium chlorate from kelp is made in Japan for the match trade. In view of the recent agitation and consequent Federal legislation affecting the production of matches in the United States, the possibility of obtaining a cheap source of potassium chlorate alone would give the giant kelps a national importance.

and the opening of the Panama Canal should make the delivery of this material at South Atlantic ports a commercial opportunity of great promise. The West Indies also are large consumers of potassium salts, and no doubt kelp could find a good market there. A very considerable market could be established in Hawaii and probably in Japan. The giant kelps of the Pacific coast are therefore a national asset of the first importance. As a local asset, especially of southern California, Puget Sound, and southeast Alaska, the possible kelp industry ranks well in comparison with any industry now existing or in sight. As a possible source of cheap potash salts and an organic nitrogen carrier it is an asset of first importance at present to the Atlantic seaboard, and, as intensive methods of cultivation become more prevalent, to the entire Nation.

The first commercial organization to attempt to utilize the giant kelps was the Coronado Chemical Co., which erected a plant at Cardiff, on the coast some miles north of San Diego. They attempted to produce a material containing soluble potassium salts and phosphates, together with other substances, by a "secret process." Shortly afterwards the Ocean Products Co. erected a plant at Halfmoon Bay for the production of distillation products and, incidentally, potassium salts. Both these companies have since been absorbed by the American Potash Co., with offices at Los Angeles and a plant at Long Beach. The Pacific Products Co. erected a plant near Point Fermin and have produced very creditable samples of potassium chloride and of iodine. The Pacific Kelp Mulch Co., with a plant at San Pedro, harvested and sold a considerable quantity of fresh kelp to local citrus fruit growers. It is reported that this concern has been absorbed by the Mexican Kelp & Fertilizer Co., of San Diego, which, working under the Bernstein concession, is harvesting and drying kelp on the Mexican coast near Ensenada and selling from that point as well as San Diego and Los Angeles.

Many other concerns have been reported from time to time, both in the newspapers and trade journals. None have yet progressed beyond the experimental stage, and many, unfortunately, appear to be nothing more than stock-jobbing or wildcat schemes, against which the public can not be too strongly warned.

All the kelp beds, with possible exceptions, are within the 3-mile limit at mean low water. Their legal status is, in the absence of any State regulations, defined in the following opinion of the Solicitor of the Department of Agriculture, to wit:

Jurisdiction over the shores of the sea below the line of high tide and for a distance of 1 marine league or 3 geographical miles out to sea from the line of low water is wholly within the respective States, subject to the paramount right of the Federal Government to regulate commerce and navigation, while the sea beyond the 3-mile limit is open to all the nations. Bays whose headlands are

not more than 6 miles apart, measuring from low water, are subject to the same extent to the jurisdiction of the State within which they lie. The right to regulate the taking of kelp within the limits above described is therefore within the several States, while neither the State nor the Federal Government has any control over the water beyond that limit.

Legislation looking to the control of the kelp beds and leasing of rights to harvest has been proposed both in Washington and California, but has not yet been effected. Apparently anyone is yet free to harvest kelp anywhere on the coast, without restrictions of any kind. This state of affairs is undoubtedly a factor in deterring large capital from exploiting the beds commercially, since there is no obvious way in which either natural or artificial advantages can be obtained to the exclusion of competition.

THE AVAILABLE SUPPLY OF KELP AND ITS VALUE.

The amount of potassium chloride which can be expected annually from a harvest of the giant kelps can now be estimated with some approach to precision. It is assumed in the estimates here given that the kelp would be cut to an average depth of 1 fathom, although greater depths probably could easily be realized in practice. The average potash content of upward of 100 samples of dried Macrocystis and Nereocystis as determined in the laboratory of the Bureau of Soils is 16.1 per cent, corresponding to about 25 per cent potassium chloride.

In Table XI are given estimates for the area, tonnage of fresh kelp, and tonnage of equivalent potassium chloride in the regions so far mapped by the Bureau of Soils. There are probably some 70 square miles of commercially available kelp beds yet to be mapped in southeast Alaska, which can produce as much as already estimated for that region, and which are included in this table. Assuming also that at least two crops a year of Macrocystis can be harvested on the California coast, we obtain as the totals about 390 square miles of kelp beds, producing annually 59,300,000 tons of fresh kelp, equivalent to 2,266,000 tons of potassium chloride. At the present time the total imports of potash salts of all kinds is about 1,000,000 tons, equivalent to about 400,000 tons of pure potassium chloride. That is to say, the giant kelps of the Pacific coast, harvested to a depth of 6 feet, could perennially yield an annual output of potassium chloride about six times the equivalent of the potassium salts now imported into the United States. It is hardly to be assumed that any such harvest of kelp is soon, if ultimately, to be realized; but it is practicable, and at least removes definitely any necessary dependence of the United States upon foreign sources of supply for potassium salts.

What it would cost to obtain the pure potassium chloride from kelp can not be stated, as sufficient experience is not yet accumulated to justify exact estimates. It should be easier to extract the potassium chloride from kelp than from the Stassfurt salts. But the cost of harvesting the kelp as well as the subsequent manipulation is, at the present time, speculative. It is easy to show by "paper calculations" enormous profits in obtaining pure potassium chloride, iodine, and possibly other products from the kelp.[1] Since, however, the dried kelp will average more than 25 per cent potassium chloride, since the organic matter decomposes very readily, and there is present nitrogenous matter equivalent to about 2 per cent nitrogen and some phosphate, it seems probable that kelp in the dried state, either alone or in mixture with other materials, such as fish scrap and standard phosphate carriers, is the form in which it is most likely to find at first a market as a fertilizer.

TABLE XI.—*Showing areas and tonnage of commercially available kelp beds of the Pacific coast.*

Region.	Area.	Fresh kelp.	Potassium chloride.
	Square miles.	*Tons.*	*Tons.*
Cedros Island to San Diego	91.36	[1] 16,979,800	649,000
San Diego to Point Conception	97.92	[1] 18,195,300	696,000
Point Conception to Cape Flattery	36.24	4,377,400	167,000
Puget Sound	5.	520,000	20,000
Southeast Alaska	70.78	7,833,000	299,000
Southeast Alaska (estimated)	70.78	7,833,000	299,000
Western Alaska	17.86	3,567,000	136,000
	389.94	59,305,500	2,266,000

[1] Two cuttings per annum.

It is also impracticable to give any close estimate of the value of the possible kelp harvest. Assuming that all the potassium chloride were extracted and marketed as such, the value at present prices would be approximately $90,000,000, whereas if the crop were all reduced to dried kelp and sold at current figures for both potash and nitrogen content, the value would be in excess of $150,000,000.

THE KELP MAPS.

The three factors predominantly influencing the attitude of capitalists toward the exploitation of the kelp beds are—

1. Control of the kelp beds. This is of importance as affecting the probable competition to be expected. The present status has been stated above.

[1] For a detailed discussion of cost the reader is referred to the Journal of the Franklin Institute, Vol. CLXXVI, p. 347 et seq., 1913.

2. Costs of manipulation. Tentative estimates can be made from the data given in this report; but no definite conclusions are justified thereby, and a demonstration on a larger scale than is practicable in the laboratory is required.

3. The location, extent, and character of the several kelp beds and the usual aids to navigation in approaching and harvesting the kelp.

The investigation of the last of these factors is evidently a work which could be done satisfactorily by the Federal Government alone. Therefore careful surveys have been made of all the commercially available kelp beds from Cedros Island to Cape Flattery, about half the beds available in southeast Alaska, and a major part of the beds on the southern shores of the Alaska Peninsula. The data obtained are shown in a series of working maps which this report accompanies. These maps are self-explanatory. With these maps and the additional information given in the following chapters, it should be perfectly practicable for anyone interested to determine beforehand where to go, how to go, and what to expect. Moreover, these maps are intended for the use of harvesters in their actual operations on the beds.

II. THE KELP BEDS FROM LOWER CALIFORNIA TO PUGET SOUND.

By W. C. Crandall,
Collaborator in Kelp Investigations.

INTRODUCTION.

During the summer of 1911 the extent, locations, and the botanical and ecological characteristics of the kelp between San Diego and Point Conception, Cal., were investigated by the author. In continuance of this work, during the summer of 1912, the author made a survey of the kelp beds from Descanso Point and Los Coronados Islands, Mexico, to Neah Bay, Wash. Prior to making this survey the extensive kelp beds from San Diego, Cal., south to Asuncion Island, Mexico, were investigated. From Asuncion Island to Point Saint Lucas little kelp was found. In the Gulf of California no kelp was found along the eastern shore and but small patches on the western shore. In the interval between the work south of San Diego and the survey of the coast line of the United States observations were made at La Jolla, Cal., on the summer life of the giant kelp *Macrocystis pyrifera.*

For carrying out the field work described in this report the yacht *Paxinosa* was employed. This vessel, owned by Col. Rader, of San Diego, Cal., and handled by Capt. J. M. Ross and Mate John Lindahl, proved an excellent sea boat, very well adapted to this investigation. She is a 50-foot, 21-ton, ketch rigged, 40 horsepower auxiliary ocean-going cruiser capable of making 7¼ knots per hour. Mr. A. McClellan assisted in the scientific work of the survey, and Mr. E. L. Michael, resident naturalist of the Scripps Institute of Biological Research, La Jolla, Cal., assisted with observations on the effect of cutting upon growth of *Macrocystis pyrifera.* Much information, especially of local conditions, was obtained from coastwise captains, lighthouse captains, life-saving crews, fishermen, and others. Particularly, acknowledgments should be made to Capt. Eaton, of the Sandoval Fishing Concession Co.; Mr. W. C. Morgan, Fort Ross, Cal.; Capt. John Olsen, St. George Reef Lighthouse, Crescent City, Cal.; Dr. Haydon, Marshfield, Oreg.; Mr. Gordon Land, Seattle, Wash.; Capt. H. O. Hansen, Astoria, Oreg.; Capt. Richardson, Lighthouse tender *Manzanita*, Astoria, Oreg.; Capt. McAfee, United States Life-Saving Service, Neah Bay, Wash.;

Capt. Farreola, Monterey, Cal.; Mr. J. M. Shiner, Los Angeles, Cal.; and Mr. H. Wilson, Halfmoon Bay, Cal.

In addition to the uses of kelp hitherto noted in Senate Doc. No. 190, the writer is informed that the Indians living east of Fort Ross formerly gathered kelp from the beach in large quantities and from it made soups which were much prized. From the bulb of the "bull kelp" Dr. Haydon, of Marshfield, Oreg., has made excellent pickles.

SURVEY FROM NEAH BAY TO POINT CONCEPTION, CAL.

Leaving San Diego the evening of August 15, the survey was conducted mainly on the trip north. From Point Conception, Cal., to Neah Bay, Wash., practically the entire way, the route varied somewhat from about a quarter of a mile offshore. Observations on the kelp beds were made carefully during the daylight trips as far as Coos Bay, Oreg. From Coos Bay to Neah Bay the work was so arranged that night runs going north were covered in daylight runs going south, effecting in this way saving of time, important because of the lack of sufficient shelter for a small boat on this part of the coast. The trip was characterized by particularly pleasant weather and smooth seas. The only delay, due to rough weather, was on account of a rough bar at Coos Bay. The return to San Diego was effected September 28. The location, area, and character of the kelp beds were plotted on charts directly, the positions being determined by sextant readings, compass bearings, and three-point apparatus. There were available for this work 52 sectional charts in the form of photographic enlargements of charts of the Coast and Geodetic Survey on a scale of 1 to 100,000, and a number of special charts, usually reductions to the same scale, showing the detail of harbors and islands along the coast. Certain of these charts covering areas in Puget Sound were not utilized in this survey, and others on areas on the coast in which no kelp beds of importance were found are also omitted in this report.

The west coast of the United States can be divided conveniently into four general sections according to direction. These sections correspond quite well to the distribution of kelp which occurs within well-defined limits.

1. Strait of Juan de Fuca to Destruction Island, northwest to southeast, rugged and extremely rocky. Some kelp is found among the rocks and reefs. Heavy stands of rockweed are frequent.

2. Destruction Island to Cape Mendocino, north to south, sand dunes, with occasional rugged stretches, and reefs off river mouths. Usually kelp is to be found among the rocks on the reefs.

3. Cape Mendocino to Point Conception, northwest to southeast, rugged, but outline broken by many bays. As regards the distribution of the kelp, this section can be regarded as of three parts:

(*a*) Cape Mendocino to Point Arena, where the kelp occurs in a sharply defined fringe along the rugged coast and in heavy masses in the bights;

(*b*) Point Arena to San Francisco, where very little kelp occurs in the low sandy bights; and

(*c*) San Francisco to Point Conception, where kelp is found in bights along the steep rugged cliffs.

4. Point Conception to San Diego, west-northwest to east-southeast, protected by islands. Not rugged. Kelp is found frequently in heavy masses opposite low bluffs, but is absent off sandy beaches.

The prevailing winds in these several sections are quite different and of considerable importance with regard to kelp. In the northern coast stretches spring and summer are characterized by strong north and west winds, while in September and October southerly winds prevail. In winter heavy winds either from the north or the south are frequent. These winds may be near shore, at other times far at sea. In either case a heavy sea is set running, which undoubtedly frees much kelp from the beds.

Along the southern coast severe winds are infrequent. The only wind materially affecting the kelp beds is the southerly wind, and this not oftener, usually, than once in three or four years. The distribution of kelp indicates that the more uniform and stable conditions of the southern coast are more favorable for kelp growth than the too strenuous conditions prevailing on the northern coast. August and September are, in fact, the only months during which quite weather can be surely anticipated on the northern coast. Fortunately, these are the months during which it is best, for other reasons, to harvest the kelp.

It happens that this year (1912) was an unusually poor one for a kelp harvest, as will be explained more in detail in later pages. Most of the beds were thinner than usual, and especially along the northern coast sections, some beds being very thin and practically nonexistent, where usually very heavy stands prevail. From general testimony it may be taken that conditions this year represented about the minimum kelp harvest the western coast of the United States produces, and the normal average stands are distinctly larger.

TABLE XII.—*Showing locations, areas, and tonnage of kelp beds from Neah Bay, Wash., to Point Conception, Cal.*

Sheet No.	Bed No.	Location.	Kind.	Density.	Length.	Breadth.	Area.	Depth.	Harbor.	Availability.
		WASHINGTON.			*Yards.*	*Yards.*	*Sq. miles (nautical).*	*Fathoms.*		
4	1	Neah Bay	N	VT	1,631	220	0.12	2 to 6	Neah Bay	Available.
	2	North side Cape Flattery	N	VH	6,880	150	.33	9	do	Do.
	3	Umatilla Reef	N	VT	14,400	50 to 6,000	13.00	18	do	Good weather.
	4	South White Rock	N and Mac	VT	2,930	600	.57	9	do	Do.
	5	Hand Rock	N	VT	900	400	.12	8	do	Do.
		OREGON.								
20	6	Yaquina Head	N	T	5,000	600	.97	6 to 8	Yaquina	Do.
21	7	Seal Rocks to Alseya Head	N	VT						Do.
23	8	5 miles north of Coos Bay	N	VT	3,500	200	.23		Coos Bay	Do.
	9	Cape Arago Light	N	T	800	220	.06	10	do	Do.
	10	Cape Arago	N	T	1,700	200 to 400	.17	(1)	do	Do.
24	11	Blanco Reef	N	T	1,700	100 to 400	.14	(2)	Port Orford	Do.
	12	Orford Reef	N	T	1,000	600	.19	(2)	do	Do.
	13	Port Orford	N	T	1,500 220	900 200	.44 .01	[2] 3 to 8	do	Do.
		CALIFORNIA.								
26	14	Battery Point to Point St. George	N	T	440	440	.06	3	Crescent City	Do.
27	15	Trinidad Head	N	M	220	75	.01	5	Eureka	Do.
29	16	Cape Mendocino	N						do	Do.
30	17	Cape Vizcaino	N	T	2,000	50	.03	[2] 6	Fort Bragg	Do.
	18	Hardys Rock	N	T	800	500	.13	(2)	do	Do.
	19	Alviso Ridge	N	T	1,700	500	.29	[2] 6	do	Do.
	20	North Abalone Point	N	H	1,600	300	.16	[2] 4 to 10	do	Do.
	21	South Abalone Point	N	M	1,500	500	.25	[2] 4 to 8	do	Do.
	22	Switzers Rock	N	T	2,000	Fringe.	.02	(2)	do	Do.
	23	Bells Point	N	T	2,000	500	.32	(2)	do	Do.
	24	Bushels Point	N	T	Patches.			(2)	do	Do.
31	25	Laguna Point to Point Cabrillo	N	M	15,840	Fringe.	.50	(2)	do	Do.
	26	Russian Gulch to Mendocino	N	M	2,640	33	.03	(2)	Mendocino	Do.
	27	Mendocino to Little River	N	H	3,080	66	.07	7	do	Do.
	28	Little River Landing	N	H	1,000	500	.16	(2)	do	Do.
	29	Big Gulch	N	M	500	200	.03	(2)	do	Do.
	30	Saddle Rock	N	(3)					do	
	31	Cuffeys Cove	N	H	1,500	Fringe.	.05	(2)	do	Do.
	32	Bridgeport Landing	N	T	5,280	Fringe.	.17		do	Do.
32	33	Point Arena to Arena Cove	N	M	5,280	67	.01	(2)	Fort Ross or Mendocino.	Do.
	34	Arena Cove South	N	M H	4,400 1,760	Fringe to 880 400	.77 .23	10½ to 14 3 to 4	do Mendocino	Do. Do.
	35	Saunders Reef to Steens Landing	N	H	6,160	66 to 1,000	1.25		Fort Ross	Do.
	36	Steens Landing to Gualala River	N	M	8,800	66	.19		do	Do.
	37	Fort Ross Cove	N	T	3,520	100	.11	3	do	Do.

34	38	Double Point to Bolinas Bay	Mac	T	3,520	66	.08		San Francisco	Available
35	39	Point San Pedro	N	VT			Patches.		do	Do.
	40	Point Montara	Mac	VT			Patches.		do	Do.
36	41	Pillar Point	Mac	T	1,960	800	.51	9½	Halfmoon Bay	Do.
	42	Point Bolsa	Mac and N	M	500	250	.04		Santa Cruz	Do.
	43	Middle Point to Point Ano Nuevo	Mac and N	M	1,400	800	.57		do	Do.
	44	Point Ano Nuevo to Big Gulch	Mac	M	3,520	600	.68	7 to 11	do	Do.
	45	Big Gulch to Swanton	Mac and N	M	5,280	Fringe.	.17		do	Do.
	46	Scotts Creek to Williams Landing	Mac and N	M	2,640	Fringe.	.09		do	Do.
37	47	Williams Landing to Sandhill Bluff	Mac	T	1,760	200	.11	7	do	Do.
	48	Sandhill Bluff to Table Rock	Mac	H	1,760	66 to 130	.05	7	do	Do.
	49	Table Rock to Pillar Point	Mac	H	5,280	160	.28	7	do	Do.
	50	Pillar Point to Point Santa Cruz	Mac	MH	4,400	300	.43	1 to 7	do	Do.
	51	Twin Lakes to Capitola	Mac	M	3,520	35 to 900	.50		do	Do.
	52	East Point Aulon to Aumentos Rock	Mac and N	M	1,320	250	.10	1⅓ to 9	Monterey	Do.
	53	Whistler to Cypress Rocks	N	H	3,520	130	.15	8	do	Do.
	54	Pescadero Point	N	T	1,760	900	.51		do	Do.
	55	North half Carmel Bay	Mac	H	1,200	600	.23	10	do	Do.
	56	Off Carmel Mission	N	H	200	200	.01	10	do	Do.
38	57	Point Sur to Cooper Point	Mac	MH	6,160	220	.44		do	Do.
	58	Pfeiffer Rock to Little Pyramid Rock	Mac and N	M	4,400	200	.29		do	Do.
	59	Pyramid to Partington Point	N	M	1,760	Patchy.	.06		Monterey or Cayucos.	Available, but long haul.
	60	Anderson Landing to Slate Rock	N	H	3,560	250 to 500	.50		do	Do.
	61	Slate Rock to Devils Canyon	N	H	7,040	66 to 130	.22		do	Do.
	62	Gamboa Point to Lopez Rock	Mac	H	1,760	100	.06		do	Do.
	63	Lopez Rock to Lopez Point	Mac and N	VH	1,760	1,320	.75	15	do	Do.
	64	Harlan Rock	Mac	M			Patches.		do	Do.
39	65	Twin Peak Cove to Mill Creek	Mac	H	3,520	70	.08		do	Do.
	66	Mill Creek	N	VH	880	130	.04	14	do	Do.
	67	Tide Rock	N	VH	880	130	.04	14½	do	Do.
	68	Prewett Creek to Cape San Martin	N	VH	3,520	400 to 500	.55	15	do	Do.
	69	Cape San Martin to Alder Creek	N	VH	5,280	Fringe to 500.	.14	14½	do	Do.
	70	Salmon Head to Salmon Cone	N	H	2,200	70	.05	11	do	Do.
	71	Point Sierra Nevada	N	T	600	400	.08		Cayucos	Available.
	72	La Cruz Rock to Harlech Castle Rock	N	M	1,760	400	.23	12	do	Do.
	73	Piedras Blancas to 3 miles southeast	N	T	3,520	130	.15	12	do	Do.
	74	3 miles southeast Piedras Blancas to San Simeon.	Mac	VH	4,400	440 to 880	1.00	12	do	Do.
	75	Pico Creek to Pico Rock	Mac	MH	4,400	70	.10	12	do	Do.
	76	Pico Rock to White Rock	Mac	M	7,920	500	1.28	12	do	Do.
39,40	77	White Rock to Point Esteros	N	MH	7,920	600 to 880	1.50	5 to 12	do	Do.
	78	Point Esteros to Cayucos Point	Mac	M	900	300	.01	4 to 7¼	do	Do.
	79	Constantine Rock to Cayucos	Mac	M	900		Patches.	5	do	Do.
	80	Point Buchon to Lion Rock	N	VT	3,520	300	.34		Oilport	Do.
	81	Pecho Rock	N	VH	2,350	600	.46	9	do	Do.
	82	White Rock to South Point Rock	Mac	M	2,350	600	.46	7	do	Do.
41,42	83	Tranquillar Mountain to Point Conception	Mac	VH	10,560	500	1.71	8 to 13	Santa Barbara	Do.

[1] Reef rocks. [2] Rocky. [3] Traces of large bed.

NOTE.—Certain unnumbered beds are shown in the maps. These beds were surveyed prior to the year 1912.

In Table XII are given the observational data for the run from Neah Bay, Wash., to Point Conception, Cal. For the most part the table is self-explanatory. The only kelps recognized as having any commercial importance were Nereocystis and Macrocystis, indicated by the symbols N and Mac, respectively, in the column headed "Kind." In the column under "Density" the symbols represent the character of the growth, as, very thin, VT; thin, T; medium growth, M; heavy, H; and very heavy, VH. The areas given are, of course, only approximations in most cases, but believed to be sufficiently accurate to furnish in the aggregate a fair computation of the available potash salts which may be expected from kelp. The column headed "Harbor" shows the nearest available port from and to which boats gathering kelp could most conveniently work. In the column headed "Availability" the word "available" means bed or grove is conveniently situated with reference to the corresponding harbor. The words "good weather" indicate that the groves are either so distant from the harbor or situated on so rocky a coast as to make it impracticable to gather the kelp with small boats and barges except during calm seas and weather.

TABLE XIII.—*Location, kind, and composition of kelps, samples collected between Point Conception and Williams Landing, Cal.*

Station No.	Sheet No.	Latitude, N.	Longitude, W.	Kind.	Potash (K_2O).	Nitrogen (N).[1]	Iodine (I).	Soluble salts.	Organic matter.	Ash.
		° ′ ″	° ′ ″		Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.
1	42	34 28 20	120 28 50	Macrocystis	14.17	2.15	0.24	33.40	62.95	3.64
2	41	34 31 10	120 31 30	do	9.35	2.72	.25	20.25	73.06	6.69
3	40	35 9 30	120 42 30	do	8.62	2.35	.14	23.14	68.26	8.60
4	40	35 10 35	120 48 40	Nereocystis	20.83	1.93	.24	49.06	47.86	3.08
4A	40	35 10 35	120 48 40	do	19.71	1.96	.25	53.50	43.02	3.48
5	40	35 26 10	120 55 0	Macrocystis	4.14	2.40	.19	13.95	82.17	3.88
6	39	35 37 30	131 13 30	do	6.06	2.68	.15	14.24	79.66	6.10
7	37	36 56 25	122 3 45	do	12.26	3.17	.18	30.52	63.28	6.20
8	37	36 57 30	122 9 0	do	12.38	2.11	.18	28.02	68.79	3.19
9	36	37 6 0	122 17 40	do	16.44	2.16	.24	35.88	59.80	4.32
10	34	37 56 30	122 46 0	do	9.52	2.38	.18	23.90	72.37	3.73
11	32	38 49 0	123 36 30	Nereocystis	16.72	2.22	.13	43.32	53.56	3.12
12	32	38 51 30	123 40 0	do	20.62	2.25	.15	45.48	51.42	3.10
13[2]	24	...	...	...	...	...	...	...	...	...
14	37	36 56 40	122 7 0	Macrocystis	[3] 17.26	2.18	.15	38.26	58.18	[4] 3.55
15	37	36 56 40	122 7 0	do	[5] 27.66	1.00	.14	56.02	41.04	[4] 2.93
16	37	36 56 40	122 7 0	do	[6] 8.13	2.10	.15	21.27	75.57	[4] 3.16
17	37	36 37 50	121 54 52	Nereocystis	[5] 16.96	2.15	.20	38.06	57.26	[4] 4.68
18	37	36 37 50	121 54 52	do	[3] 23.82	2.41	.17	50.51	47.26	[4] 2.22
19	37	36 37 50	121 54 52	do	[7] 21.70	1.58	.18	46.50	50.20	[4] 3.20

[1] Nitrogen determination by T. C. Trescott, Bureau of Chemistry.
[2] Sample lost.
[3] Young plant.
[4] Determination by L. A. Steinkönig, Bureau of Soils.
[5] Old plant.
[6] Young plant growing from near bottom of old plant.
[7] Very old plant.

In Table XIII are given the results of analyses by Lindemuth and Parker of samples of kelp collected from the points indicated. These results confirm those hitherto obtained, the potash and nitrogen content being somewhat higher on the whole than from previous analyses.

THE KELP GROVES SOUTH OF SAN DIEGO.

The kelp south of San Diego is practically all *Macrocystis pyrifera*. It occurs in large beds of heavy stands as far south as Asuncion

Island. Below this to Point St. Lucas little kelp was found, although it is reported as growing as far as Magdalena Bay. A little kelp only, in small patches, was found in the Gulf of California, along the western shore. The observational data obtained are given in Table XIV, where the headings and symbols have the same significance as in Table XII.

TABLE XIV.—*Showing results of the survey of Macrocystis beds from San Diego south along Mexican coast to Cedros Island.*

Sheet No.	Kelp bed No.	Density.	Length.	Breadth.	Area.	Harbor.
			Miles.	*Miles.*	*Sq. mi. (Nautical).*	
52	84	VH	1.50	0.25	0.37	San Diego.
	84a	VH				
53	85	M	2.50	.50	1.25	Do.
	86	M	1.00	.10	.10	Ensenada.
	87	M	1.50	.12	.18	Do.
	88	M	3.00	.06	.18	Do.
	89	M	1.75	.12	.21	Do.
	90	M	2.50	.50	1.25	Do.
	91	H	2.00	.50	1.00	Do.
	92	H	3.00	.75	2.25	Do.
54	93	VH	2.25	.25	.56	Do.
	94	M	2.25	.25	.56	Do.
	95	MH	1.75	.50	.87	Do.
	96	VH	1.50	1.50	2.25	Do.
	97	H	3.50	1.00	3.50	Do.
	98	M	1.00	.12	.12	Do.
	99	VH	2.00	.25	.50	Do.
	100	VH	5.00	.37	1.87	Do.
55	101	VH	6.00	.75	4.50	Do.
	102	VH	1.50	.75	1.12	Do.
	103	M	.50	.75	.37	Do.
	104	M	1.50	.37	.56	Do.
	105	VH	2.75	.75	2.06	Do.
56	106	VH	1.50	.75	1.12	Do.
	107	H	9.00	1.25	11.25	Do.
	108	VH	2.00	.50	1.00	Do.
	109	M	3.00	.12	.35	Do.
57	110	H	3.00	.12	.36	Do.
	111	VH	1.50	.12	.18	Do.
58	112	MH	7.00	2.00	14.00	San Quentin.
	113	H	8.00	.62	5.00	Do.
	114	H	2.75	.75	2.06	Do.
	115	VH	2.75	.75	2.06	Do.
	116	VH	2.50	.50	1.25	Do.
60	117	VH	1.50	.37	.56	Do.
	118	H	2.50	.50	1.25	Do.
61	119	VH	1.00	.50	.50	Do.
	120	VH	1.00	.37	.37	Do.
	121	VH	2.00	1.00	2.00	Do.

The data obtained from analyses of samples of kelp by J. R. Lindemuth and E. G. Parker are given in Table XV. It will be observed that the total soluble salts and, in consequence, the potash content is generally low. This does not indicate that the plants in these localities actually have a normal low content of potash, as samples obtained on other occasions showed as high content of potash as the kelp gathered elsewhere. In this connection attention may be called to the samples from La Jolla and to a comparison of samples from the same groves previously analyzed by Turrentine and reported in Senate Doc. No. 190, page 221. It is very probable that in the present case much of the soluble salts effloresced on the surface of the drying plants and was shaken off and lost in the process of drying.

TABLE XV.—*Location and composition of kelp (Macrocystis pyrifera) samples collected on preliminary trip from San Diego south along the Mexican coast to Cedros Island.*

Station No.	Sheet No.	Latitude, N.	Longitude, W.	Position.	Wet weight of sample.	Dry weight of sample.	Potash (K_2O).	Nitrogen (N).[1]	Iodine (I).	Soluble salts.	Organic matter.	Ash.
		° ′ ″	° ′ ′		*Pounds.*	*Pounds.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
20	52	32 34 0	117 9 30	Off Imperial Beach, near San Diego, Cal.	6.00	1.00	6.68	1.93	0.27	23.12	67.47	9.40
21	52	32 32 0	117 9 0	Off monument, international boundary, near Tia Juana, Mexico.	7.50	.75	3.20	1.56	.18	16.56	76.46	6.98
22	53	32 25 30	117 7 0	Off Descanso Point, Mexico	7.25	1.25	6.33	1.52	.23	19.51	77.17	3.32
23	53	32 22 0	117 14 0	South of Coronado Islands	9.50	1.25	7.98	1.81	.14	23.69	67.72	8.60
5A	52	32 51 30	117 17 6	La Jolla, Cal., station 3, (Sheet XVIII, S. Doc. No. 190, 1912)	5.00	1.00	7.18	.64	.22	20.34	76.50	3.16
5B	52	do	do	do	5.00	1.00	6.79	.79	.25	20.12	76.55	3.32
5C	52	do	do	do	5.00	1.00	6.39	.66	.24	18.62	77.77	3.60
5D	52	do	do	do	5.00	.84	7.82	.67	.23	24.06	72.40	3.54
5E	52	do	do	do	5.00	.86	6.50	.54	.22	22.22	74.86	2.92

[1] Nitrogen determinations by T. C. Trescott, Bureau of Chemistry

OBSERVATIONS ON THE GROWTH OF NEREOCYSTIS.

Varied and sometimes conflicting testimony was secured regarding the growth of Nereocystis, and further observations are much needed.[1] The weight of known evidence indicates that the plant is an annual, but heavy beds are known to persist for longer periods than a year's growth if not too much disturbed by heavy seas. The Nereocystis grows very rapidly, and usually makes its presence obvious along the northern sections of the coast during June, July, and August. The thickness of the beds varies, sometimes considerably, from year to year. There is an impression prevailing commonly among the fishermen that the growth follows a three-year cycle, a thin stand being followed by a medium, then a heavy one, and a return the fourth year to a light stand. That such a cycle exists lacks confirmation by competent, trained observers, but there is no doubt whatever that the crop of kelp does vary considerably from year to year.

It would seem, however, to be something more than a coincidence that the kelp beds from a point below Cape Mendocino northward should have been so scanty this year, and the fact is scarcely to be explained by the hypothesis of destruction by a heavy storm. Conclusive evidence was obtained that even heavy beds in former years were this year almost if not entirely absent. Much testimony along this line was obtained.

Capt. John Olsen, St. George Reef Lighthouse, stated that this year he could go around freely amongst the rocks of the reef with his launch, while in many years he would be unable to do so; that inside of Castle Rock there is usually a dense bed of kelp, but it was absent this year. Local seamen asserted and the Coast and Geodetic Survey charts show the presence of kelp about Cape Mendocino, but only a few scattering specimens were found this year. Local fishermen reported that near Fort Bragg the kelp (Nereocystis) is heavy from June to October, but disappears during heavy weather. The kelp seen in this region in August was very dark and well matured. Around Ano Nuevo the general impression is held that the bull kelp and ribbon kelp remain the year round. The plants seen here were not as well matured as those farther north.

[1] Dr. Haydon, of Marshfield, Oreg., has kindly consented to observe the growth in his neighborhood and furnish a report later.

TABLE XVI.—*Observations on Nereocystis. Specimens selected from center of beds, September 21, 1912.*

Station No.	Length of leaves.	Weight.	Length.	Diameter of bulb.	Age of plant.
	Feet.	*Pounds.*	*Fathoms.*	*Inches.*	
17	9	20	4	5	Old.
18	9	10.50	4	3.50	Young.
18	12	30	3.50	5.50	Do.
18	6	16.50	3.50	4	Do.
18	6	15.50	3.16	3.75	Do.
18	9	14	3.16	3.25	Do.
18	6	15.25	3	4	Do.
18	6	13	3.16	4	Do.
18	12	14.50	....	3.75	Do.
19	12	20.50	....	4.50	Do.
19	18	33	....	5.25	Old.

In Table XVI are given some measurements on Nereocystis plants from beds in the neighborhood of Pacific Grove, Cal. These plants were taken from thin beds, but from near the center in each case. The depth at the inside of these beds varied from $1\frac{1}{3}$ to $3\frac{1}{2}$ fathoms, while the depth outside varied from $8\frac{1}{2}$ to $9\frac{1}{2}$ fathoms. On the ocean frontage, however, plants were found in much deeper water.

From the observations made and information gathered from others it seems clear that the Nereocystis should not be harvested earlier than the middle of July, as already suggested by Rigg, Senate Doc. 190. It seems very probable that it would be wiser to postpone harvesting until three or four weeks later than this date, especially if it can be found advantageous by so doing to utilize the labor and facilities of the fishing industry in a combined fish-scrap and kelp industry.

Pelagophycus porra (Pl. XXII) has apparently a life history very similar to *Nereocystis luetkeana*, since old specimens are most abundant during late summer. Because of its small quantity, however, this kelp has little significance as a possible source of potash.

OBSERVATIONS ON THE GROWTH OF MACROCYSTIS.

Observations were made on the growth, after cutting, of *Macrocystis pyrifera* at San Pedro, Santa Cruz, and La Jolla. It has hitherto been supposed that Macrocystis could be cut without damage to the plant, and it has been stated repeatedly that a cut or torn bed would regain its former luxuriance in from 40 to 60 days. At San Pedro, where cutting has been going on for some months on a rather extensive scale by the Pacific Kelp Mulch Co., it is reported that no damage has been observed in the cut-over areas. The writer examined these beds personally on September 25 and again October 12. Many cut tips showed no change, while many others showed definite signs of decay. On September 21, measurements were made at Santa Cruz of the length between nodes on the stipes of old and young plants of Macrocystis. The data are summarized in Table XVII.

TABLE XIII.—*Variation in distance between fronds of old and medium-aged plants.*

Age of plant.	Number of fronds.	Length of plant.	Distance between nodes.		
			Base.	Middle.	Top.
		Feet.	*Inches.*	*Inches.*	*Inches.*
Medium-aged plant	113	60	20 to 30	3 to 10	0 to 3
Old plant	112	....	19.5 to 31	3 to 19	0 to 3

It was found that the greatest growth is proximal, while distally tip splitting occurs. This may indicate that topped plants continue to lengthen internodally, although the tip does not regenerate. After a time, apparently, decay sets in and a new sprout is sent up from the base.

During August and September observations were made at La Jolla upon Macrocystis plants which had been topped. During the absence of the writer the observations were made by Mr. Michael. Seven stations were located near La Jolla, the growing tips of some plants were removed, while 20 other plants were marked and watched as controls. The method of procedure was as follows:

A station suitable for the work was selected and located by means of the intersection of two lines of conspicuous land sights. For example, station 7 was located at the intersection of a line passing along the east edge of a cape and the west corner of a little greenhouse, with a line passing over the middle of a small green pavilion and into a large park flagpole. In this manner each station could be satisfactorily "picked up" without involving the use of buoys or sextant. After locating a station, from 5 to 10 healthy plants were selected for observation. To those used as control a shingle bearing an identification number was attached with heavy fishline at a distance equivalent to the length of the shingle (15 inches) below the tip. Of the remaining plants the growing tips were cut away, the amount removed varying from 15 inches to 6 feet, and a numbered shingle was similarly attached 15 inches below the cut end.

Until August 12 from five to six hours were consumed each day in inspecting each of the marked plants and recording its condition. These visits, however, demonstrated that observations could be successful only when made early in the morning, for after the wind "came up" the currents so generated would submerge the plants. Owing to the frequency of fog in the early morning daily visits were abandoned, and the best that could be done was to wait for a good day. In this manner the observations were continued until September 24, each station being carefully examined on August 12 and 24 and on September 2, 17, and 24.

Many unexpected factors operated against the success of these experiments. The constantly changing direction of tidal currents,

for instance, would tangle the plants and at times cause them to break off below the attachment of the shingle, thus causing the loss of the latter and rendering it impossible to relocate the plant. Nevertheless, in spite of the vitiating effects of such conditions, enough data were obtained to justify their consideration. The final results of these observations are brought together in Table XVIII.

TABLE XVIII.—*Rate and method of growing of Macrocystis—Observations at La Jolla, Cal.*

Date.	Station.	No. of plant.	Treatment.	Time watched.	Result.
				Days.	
Aug. 2	I	1	Tip broken off	22	Decayed.
		2	Control plant	22	Showed no growth.
		3	do	22	Broke off.
		4	do	22	Plant decaying.
		5	Tip cut off	22	Do.
		6	1 fathom removed	22	Do.
		7	do	22	Do.
		8	2 fathoms removed	22	Do.
		9	do	22	Do.
		10	Cut off to surface of water	22	Do.
2	II	11	Control plant	10	Lost.
		12	do	10	Do.
		13	do	10	Do.
		14	do	20	Do.
		15	1 fathom cut off	30	Cut tip decayed.
		16	do	30	Do.
		17	do	30	Do.
		18	2 fathoms cut off	30	Do.
		19	do	20	Lost.
		20	do	30	Cut tip decaying; healthy.
Aug. 3	III	21	Control plant	45	Decayed.
		22	do	10	No change.
		23	do	10	Do.
		24	1 fathom cut off	10	Do.
		25	do	10	Do.
		26	do	10	Do.
		27	2 fathoms cut off	10	Do.
		28	do	45	Decayed.
		29	Cut off at water line	10	No change.
3	IV	30	do	10	Do.
		31	Control plant	10	Do.
		32	do	10	Do.
		33	do	10	Do.
		34	1 fathom cut off	10	Do.
		35	do	10	Do.
		36	do	10	Do.
		37	2 fathoms cut off	10	Do.
		38	do	10	Do.
		39	Cut off at water line	10	Do.
		40	do	10	Do.
Aug. 5	V	41	Control plant	10	Lost.
		42	do	10	Healthy; no change.
		43	do	30	Tip from 1½-inch.
		44	1 fathom cut off	30	Healthy; no change.
		45	do	30	Do.
		46	do	10	Decaying.
		47	2 fathoms cut off	30	Decayed.
		48	do	10	No change.
		49	Cut off at water line	10	Do.
		50	do	10	Do.
Aug. 6	VI	51	Control plant	7	Do.
		52	do	7	Lost.
		53	do	7	Do.
		54	1 fathom cut off	7	Do.
		55	do	7	Do.
		56	2 fathoms cut off	7	Do.
		57	do	7	Do.
		58	do	7	Do.
		59	Cut off at water line	7	Do.
		60	do	7	No change.
6	VII	61	Cut off 1 fathom under water	25	Do.
		62	do	25	Shingles found; separated from plants.
		63	do	25	Do.
		64	do	25	Do.
		65	do	25	Do.

While these observations are too fragmentary to establish positive conclusions, the following facts relative to the growth of *Macrocystis pyrifera* after the tip has been removed are significant: First, the fact that during the two months that the experiments lasted control plant No. 43 had apparently increased an inch or more in length demonstrates that observations upon the cut plants had lasted long enough to permit the recognition of growth had any occurred. Second, in no instance was there any evidence of growth in the region of the cut. Third, if the observations made on the different days with respect especially to plants Nos. 1, 15, 16, 17, and 20 be compared, it will be seen that they gradually decayed after being cut. Finally, several instances are recorded where the upper foot or so of the cut plant had been torn away in a state of putrefaction, and nearly every plant examined after being cut gave evidence to some degree at least of disintegration in the region of the cut. These facts all indicate that removal of the growing tip of Macrocystis causes the stem to disintegrate, the probability being that if the act of cutting stimulates any growth at all such growth takes place in the region of the holdfast; certainly not in the vicinity of the cut end. Finally, as a result of all these observations at San Pedro, Santa Cruz, and La Jolla, it seems necessary to conclude that generally, if not always, the result of cutting a Macrocystis plant is to bring about a gradual decay of the particular stipe from the region of the cut back toward the holdfast, and that the regeneration of a cut bed is mainly, if not entirely, from the growth of new stipes, starting at or near the holdfast. The rate of growth is very difficult to ascertain, but beds at La Jolla and Encinitas, which were practically washed away by the storm of March 9 and 10, 1912, are rapidly being replaced by new beds. Possibly from one to two years' time will be needed for the bed to regain its former thickness.

A similar condition was noticed by Dr. Ritter, of La Jolla, some years ago, and then it took about two years for the bed to recuperate. In these cases the plants were destroyed and new plants had to develop from the bottom. These new plants were probably started from spores from the few plants remaining. The rate of growth shown in these cases would not be the same as in the case of cutting off the tops; the latter would probably give a much faster rate of growth. From observations made at San Pedro the rate of growth must be very rapid in topped plants. This problem is now being studied at San Pedro.

Quite a number of measurements were made of the depth at which Macrocystis grows in typical beds. The inner or shore side of these beds varied in depth from $1\frac{1}{3}$ to $3\frac{1}{2}$ fathoms, but averaged close to $2\frac{1}{2}$ fathoms, while the outer or seaward edge varied in depth usually from 4 to 7 fathoms, averaging $5\frac{3}{4}$ fathoms. Generally, in northern

waters, the Macrocystis was found at shallower depths, but plants were occasionally found at quite as great depths as in southern waters.

POTASH AVAILABLE FROM KELP.

In the survey of the kelp beds from San Diego to Point Conception and about the outlying islands made in 1911 there was found an aggregate of 97.92 square statute miles. The kelp from these beds, cut to a depth of 1 fathom would total 9,097,650 tons, which would yield approximately, assuming a content of 4 per cent potassium chloride, 363,882 tons.

In the survey this year from Cape Flattery to Point Conception the total area of the kelp beds found was 36.24 square statute miles. The details of the areas of different densities of stand are given in Table XIX.

TABLE XIX.—*Area of kelp beds.*

Kind.	Location of bed.	Very thin.	Thin.	Medium.	Heavy.	Very heavy.
		Sq. yds.	*Sq. yds.*	*Sq. yds.*	*Sq. yds.*	*Sq. yds.*
Macrocystis	Washington	....	....	....	....	....
	Oregon	....	....	....	....	....
	Chetko Cove to Point Arena, Cal.	....	....	....	....	....
	Point Arena to Point Conception, Cal.	....	2,152,300	12,284,000	2,142,100	8,377,600
Nereocystis	Washington	40,988,800	1,032,000	358,800	....	....
	Oregon	700,000	6,130,200	....	....	....
	Chetko Cove to Point Arena, Cal.	....	3,132,100	2,502,400	1,338,200	....
	Point Arena to Point Conception, Cal.	1,056,000	2,633,600	8,855,800	7,457,900	3,776,100
Macrocystis and Nereocystis.	Washington	1,758,000	....	....	....	....
	Oregon	....	....	....	....	....
	Chetko Cove to Point Arena, Cal.	....	....	....	....	....
	Point Arena to Point Conception, Cal.	....	....	3,260,400	....	2,323,200

In calculating the weight of wet kelp to a depth of 1 fathom in the area surveyed it was estimated, where the very thin beds were omitted, that the average weights of kelp in a cubic yard of Macrocystis, Nereocystis, and mixed beds north of Point Conception amount to 30, 90, and 50 pounds, respectively. The calculated results are given in Table XX, and also the estimated total amount of potassium salts available, since it has been shown that the proportion of these salts in wet kelp amounts to approximately 4 per cent or more.

TABLE XX.—*Calculated quantities of wet kelp and potassium salts in the beds between Neah Bay, Wash., and Point Conception, Cal.*

Kind.	Area of beds.		Wet kelp.	Potassium chloride.
	Sq. yards.	*Sq. miles.*	*Tons.*	*Tons.*
Macrocystis	24,956,000	8.06	748,680	29,948
Nereocystis	79,961,900	25.81	3,349,540	133,982
Macrocystis and Nereocystis	7,341,600	2.37	279,180	11,167
Total	112,259,500	36.24	4,377,400	175,097

The total area of the beds surveyed from San Diego south to Cedros Island amounts to 80.95 square nautical miles, or 91.36 square statute miles, equal to 282,996,700 square yards. Again, taking 30 pounds as the average weight of wet kelp per cubic yard, the total weight of kelp to a depth of 1 fathom in this area will thus amount to 8,489,900 tons, capable of yielding 339,596 tons of potassium chloride, calculated on the basis of a 4 per cent content of this salt.

From the above figures it appears that on the Pacific coast of the United States from Cape Flattery to San Diego there are at least 134.16 square miles of kelp beds which can be made to yield annually at least 540,000 tons of potassium chloride and probably considerably more if later experience shows it to be practicable to get more than one cutting a year from the Macrocystis beds.

Including also the beds on the Mexican coast to Cedros Island, there is a total area of kelp beds of 225.52 square statute miles, capable of producing at least 878,400 tons of potassium chloride.

COMMERCIAL DEVELOPMENT.

The various methods now in use for gathering kelp may be enumerated as follows:

1. Gathering by hand the kelp thrown up on the beach by waves. This is done to a limited extent by farmers and others, but has little or no commercial importance. Dried kelp is being used successfully as a fertilizer in the neighborhood of Monterey.

2. Gathering by hand from the beds and carrying ashore in barges.

3. Cutting by rotating knife and allowing kelp to float or wash ashore. This method has been employed by the Coronado Chemical Co., but is to be improved and the kelp brought ashore in barges. The kelp is cut 6 to 8 feet below the surface of the sea.

4. Cutting by reciprocating knives and then conveying by endless chains onto barges. The cutting is done from 16 to 18 inches below the surface. The Pacific Kelp Mulch Co. is using this method successfully at the Point Fermin beds, near San Pedro. So far, after several months' trial, no apparent harm has been done the beds cut over.

5. Swinging horizontal knives and underswinging endless chain, cuttings being made 8 to 10 feet below the surface. This method is suggested by the Pacific Kelp Co. at Pillar Point.

At the present writing there are four companies engaged in the kelp business on the Pacific coast. A number of other companies have been announced in the newspapers and in similar ways, some of which seem to have a substantial basis, although others, it is to be feared, are little more than stock-jobbing propositions. The companies actually engaged at the present time are the American Potash Co., with offices in Los Angeles and a plant under construction at Long Beach; The Pacific Kelp Mulch Co., with offices at Los Angeles and a factory at San Pedro; The Pacific Products Co., with a factory operating on the coast above Point Fermin; and another company of the same name, The Pacific Products Co., with offices in Seattle and a plant at Anacortes for the preparation of kelp, together with the extraction of oil and preparation of fish scrap from cannery wastes, dogfish, and other nonfood fishes.

The Pacific Kelp Mulch Co. cuts the harvested kelp into lengths of about 6 inches. The material is sold wet to the farmers for a top-dressing and to be incorporated in the soil, especially in citrus orchards. The product deliquesces, is wet, soon decomposes, and involves paying freight on a large percentage of water, so that it can probably be shipped at a profit for short distances only. Samples of the products of this company were collected and sent to the laboratories of the Bureau of Soils at Washington. Although sent in carefully closed Mason jars the samples had decayed more or less before they could be removed from the jars and analyzed. For this reason the potash content alone was determined. The results obtained are given in Table XXI, which is self-explanatory.

TABLE XXI.—*Analyses of Macrocystis collected by the Pacific Kelp Mulch Co.*

No. of sample.	Description.	Content of potash.	
		Wet.	Dry.
		Per cent.	*Per cent.*
1	From field of W. P. Watts, Corina, 48 hours after being applied	1.9	15.1
2	From wagon unloading on field of S. P. Moore, Azuza [1]	2.0	14.9
3	Cut at Terminal Island, Sheet No. 47; from car loading	1.7	16.5
4	Cut at Terminal Island, Sheet No. 47; from barge unloading	1.2	18.5

[1] Inspection of this field Dec. 22 showed it to be much improved and in far better condition than adjacent fields not treated with kelp.

The data obtained for the dried samples show this kelp to be very satisfactory, indeed, as a source of potash; but the data for the wet material indicate too low a content of potash to justify it being extensively used. There can be no economy in paying freight and haulage on water.

The Coronado Chemical Co. had an experimental plant at Cardiff, about 20 miles north of San Diego, on the coast and opposite large kelp groves. It was originally planned by this company to cut the kelp by horizontal knives suspended from either side of a boat especially constructed to work through the kelp beds and to float ashore the cut kelp, which would then be air dried on the shore. It is claimed that their cutting device has been perfected and that they now propose to carry the cut kelp ashore in barges and to finish the drying in some mechanical device employing artificial heat. By a "secret process" this company expects to obtain pure potassium salts, iodine and other by-products, organic and inorganic, for which a ready sale exists. It is reported that they have marketed some potash salts.

The Pacific Kelp Co. had an experimental plant at Halfmoon Bay, near San Francisco. This company dried its harvested kelp in an artificial drier, the kelp then being baled and carried to the factory.

The Coronado Chemical Co. and the Halfmoon Bay Co. subsequently were absorbed by the American Potash Co. and the apparatus all moved to Long Beach.

ROCKWEED.

An additional quantity of potash might be gotten from the rockweed, which grows very profusely from Monterey to Neah Bay wherever there is a rocky coast. If it were possible to harvest the rockweed, there would probably be a greater tonnage of it than of the kelp through that district. Dr. McFarland, Senate Doc. No. 190, studied the quantities available in small areas. His observations would indicate that an enormous tonnage might be obtained from Destruction Island, Wash., to Neah Bay.

III. THE KELP BEDS OF PUGET SOUND.

By George B. Rigg,
Scientist in Kelp Investigations.

TIME OF INVESTIGATION.

The work reported in the following pages was done in September and October, 1912. It is a continuation of the work done during the summer of 1911, the report of which was published as a portion of Senate Doc. No. 190.

RELATION OF KELP TO THE SALINITY OF THE WATER.

Attention was given in particular to a study of the effect of fresh water on the growth of kelp as seen in the bed in Fresh Water Bay near the mouth of the Elwha River. The Elwha is a snow-fed stream originating on the southwestern slope of Mount Olympus. It flows north and discharges into the Strait of Juan de Fuca some 6 miles west of the city of Port Angeles, Wash. It is the largest stream flowing into the Strait of Juan de Fuca or Puget Sound from the Olympic Mountains. The monthly maximum and minimum discharge of this river is given in the Twentieth Annual Report of the United States Geological Survey, Part IV, page 521, in cubic feet per second, for the period from October, 1897, to December, 1898. For the portion of the year 1897 covered by this report the maximum discharge occurred in November and was 7,075 second-feet, while the minimum occurred in October and was 171 second-feet. For 1898 the maximum, 3,282 second-feet, occurred in June, and the minimum, 330 second-feet, occurred in October. The mean for the period reported is 1,444 second-feet. These observations were taken at McDonald, Wash. This is above the outlet of Lake Sutherland and also the outlet of Little River, so that the actual discharge of the river was somewhat greater than the above figures show. Mr. G. W. Northrup, superintendent of operation of the power plant of the Olympic Power Co. on the Elwha, states that the minimum discharge of the river for the year 1912 has been between 400 and 500 second-feet, and that the maximum reaches an enormous amount each year during flood-water periods: that is, in May and November.

Fresh Water Bay does not form a harbor. The distance in a straight line from Angeles Point, which marks the eastern side of the bay,

to Observatory Point at its western side is 4 miles, while the maximum distance to shore in the bay, measured at a right angle from the above line, is only 1 mile. The strong tidal currents flowing in and out through the Strait of Juan de Fuca sweep freely through this bay. There is a good beach along practically the whole bay. The field observations on the kelp beds in this bay were made on September 11 and 12. On September 11 the surf was so heavy that it was deemed impracticable either to enter the mouth of the river in the 50-foot launch, in which the trip was made, or to land with a skiff in the more exposed portion of the bay. The launch was anchored in the more protected portion of the bay behind Observatory Point. A landing was readily made with the skiff from this point.

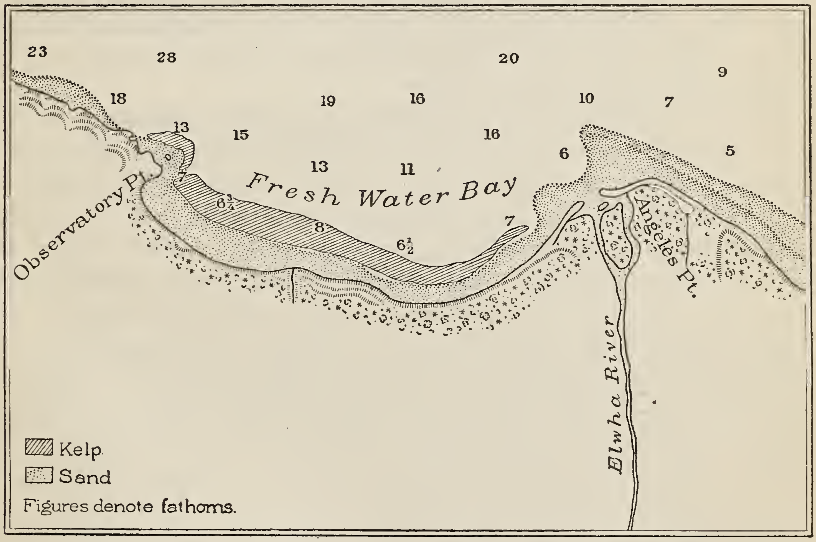

FIG. 2.—Map showing the location of the grove of Nereocystis in Fresh Water Bay, Washington.

On the afternoon of September 12 the water in the bay was much quieter, and we entered the mouth of the river in the launch.

There is no kelp at all opposite the mouth of the Elwha River. The river enters the bay by two mouths, and the first kelp plants found were about half a mile west of the west mouth. At this end of the bed the kelp plants are scattering and of medium size. A little farther west the bed becomes quite dense and continues so to a point near Observatory Point. The bed is not closer to the beach than one-fourth of a mile at any point. The bed is more than 500 feet wide in places and is over 2 miles long. There is also a good deal of kelp around Observatory Point. The bladder kelp, *Nereocystis luetkeana*, is the only kelp found growing in this bed. *Macrocystis pyrifera* was found floating in the bay, but not attached.

Hydrometer readings to determine the density of the water were made at the most eastern point at which kelp was found in the bay, at the west end of the beds, and at several intermediate points. Readings for comparison were also made at several points in the open strait. A reading was made in the mouth of the river and one at a point about 500 feet directly out from the mouth. All readings were taken at a temperature of 15.5° C., that being the temperature to which the zero point of the instrument was adjusted. The water of the river proved to be exactly this temperature, while the samples from the kelp bed and the open strait varied from 12.5° C. to 13.5° C. There was found to be no difference in the hydrometer readings taken in the open strait and those taken at any of the points where kelp grew in the bay. The reading taken in the mouth of the river was zero. The reading taken about 500 feet straight out from the mouth of the river showed about one-third as great a salinity as the water of the strait and of the bay.

The facts are, then, that a strong tidal current sweeps freely through this kelp bed, and the water at all points in it shows the normal salinity of the water of the strait. So far as this bed is concerned, kelp does not grow in water that has less than the normal salinity. It does not seem quite possible, however, to say positively that the lack of normal salinity is the only inhibiting factor preventing the growth of kelp near the mouth of the river, although it seems to the writer that such is probably the case. Outside of the question of the salinity of the water, there are at least three factors that limit the distribution of Nereocystis in the Puget Sound region. These are rocks for anchorage, a strong tidal current, and proper depth of the water. The strong tidal current is present at the mouth of the river, as it is in the other portions of the bay, and the water is of proper depth for kelp, a little distance offshore, as it is in the other portions of the bay where kelp does thrive abundantly. It may be possible that the silt brought down by the river has so covered the rocks near the mouth of the river as to render the attachment of kelp impossible.

It seems quite possible that the contamination of the water by sewage or other wastes might have a detrimental effect on the growth of kelp, but the writer has not found any place where the water is so contaminated. Since mature Nereocystis and Macrocystis plants have their fronds at the surface of the water, light is a factor in their distribution only in their very young condition.

COLLECTION AND ANALYSES OF SAMPLES.

Samples of both Nereocystis and Macrocystis were collected as indicated in the following tables. These were cut into coarse pieces and dried in the sun. The dried samples with the coatings of

efflorescent salts were carefully sealed in glass jars and forwarded to the laboratories of the Bureau of Soils at Washington. The analyses were made by Messrs. E. G. Parker and J. R. Lindemuth.

TABLE XXII.—*Composition of kelp samples (Nereocystis luetkeana) from Fresh Water Bay, Puget Sound, collected Sept. 11 and 12, 1912.*

Part of plant and location of bed.	Potash (K_2O).	Nitrogen (N).	Iodine (I).	Soluble salts.	Organic matter.	Ash.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Fronds of plant, west end of bay	18.04	2.26	0.23	44.17	51.13	4.80
Do	17.61	2.21	.24	44.70	51.11	4.72
Stipes from two plants, west end of bay	31.62	1.21	.25	63.75	33.15	3.46
Fronds from plant, east end of bay	16.92	2.57	.20	43.37	51.16	5.47
Do	17.05	2.71	.24	41.53	51.67	6.30
Do	17.32	2.53	.28	45.40	50.12	4.48
Do	16.20	2.54	.19	42.88	52.19	4.98
Stipes from plant, east end of bed, nearest mouth of Elwha River	16.50	2.21	.30	59.24	37.40	3.36
Do	16.72	1.46	.20	57.06	39.02	3.92

TABLE XXIII.—*Composition of kelp samples (Macrocystis pyrifera) near Low Point, Puget Sound, collected Sept. 11, 1912.*

	Potash (K_2O).	Nitrogen (N).	Iodine (I).	Soluble salts.	Organic matter.	Ash.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Fronds	11.82	2.43	0.22	28.32	67.78	3.90
Stipes and fronds	12.80	1.37	.23	34.42	59.40	6.18

It does not appear from these analyses that there is any special difference in the percentage of total soluble salts, organic matter, or potash between fronds and stipes or between plants nearer to or distant from the mouth of the river. The stipes from the sample of Nereocystis taken from the western end of the bed are, it is true, much higher than the fronds in content of soluble salts and of potash, but this is probably accidental rather than typical, for no such difference appears with plants selected from the eastern end of the bed or with the Macrocystis plants. The Macrocystis plants appear to contain distinctly less potash than the Nereocystis plants. The analytical data here given show the dried Nereocystis to contain approximately 30 per cent potassium chloride, or, discarding the very high result for stipes collected at the west end of the bed, upward of 27 per cent potassium chloride. The Macrocystis plant, however, contained only about 20 per cent potassium chloride. It is not to be concluded, however, that Macrocystis is essentially less rich in potash than Nereocystis, although the weight of existing data is in this direction. The important point is that both plants are very high in potash content.

On September 28 two plants were collected from the kelp grove at Blakely Rock, near Seattle, and samples dried in the sun until there

was no further loss in weight. One-pound samples of stipes and fronds, respectively, yielded the data given in Table XXIV.

TABLE XXIV.—*Loss of weight by drying wet kelp.*

Part of kelp used.	Weight of dried plant.	Water lost.
	Ounces.	*Per cent.*
Stipes	1.468	91.8
Do	1.465	91.6
Fronds	1.462	91.4
Do	1.465	91.6

Twelve feet of the small ropelike solid portion of the stipe, taken from just above the holdfast, was found to weigh 11 ounces, or about 0.91 ounce per foot.

CHARACTER AND DISTRIBUTION OF KELP BEDS OF THE PUGET SOUND REGION.

A more detailed study was made of the location and extent of the kelp beds along the American shore of the Strait of Juan de Fuca and in Puget Sound proper (Port Townsend to Olympia) than had been made in 1911. Considerably more kelp was found in the strait and on the west coast of Whidbey Island than had formerly been reported. The location and extent of all beds, whether observed in 1911 or 1912, are shown on the maps accompanying this report. These maps supersede maps 1, 2, and 3 of Senate Doc. No. 190.[1]

All of the kelp beds referred to above and shown on the maps are a pure stand of *Nereocystis luetkeana*, except the beds situated in the Strait of Juan de Fuca from Low Point to Cape Flattery. In many of these beds there is a broad bed of Nereocystis flanked toward the shore by a narrow bed of *Macrocystis pyrifera*. This relative situation of the two species seems to be general in this region, Macrocystis always growing closer to shore and Nereocystis a little farther offshore, in somewhat deeper water. In the beds in the vicinity of Neah Bay there is a good deal of *Egregia menziesii* mixed with the Macrocystis.

The three kelps just mentioned are the only ones in the Puget Sound region provided with floats so that they are buoyed up in the water. Nereocystis attaches itself to rocks by means of a powerful, much-branched holdfast. From this there arises a slender ropelike stipe which is very strong and flexible. Plate II, figure 2, shows a Nereocystis plant of moderate growth. This stipe gradually enlarges upward into a hollow tubelike pneumatocyst which terminates in a hollow bulb at the top. The pneumatocyst of a mature specimen is

[1] Beds platted in 1911 are unnumbered.

commonly constricted slightly just below this bulb. Upon the bulb are two groups of slender, ribbonlike fronds. This bulb is always at the surface unless swept under by a very strong tide. It is erect at high tide. At low tide the bulb with several feet of the pneumatocyst lies upon the surface of the water. In either position the fronds are always entirely submerged and are swept out parallel to the surface of the water by the tidal current. The region of the increase in length of these plants is the bulb. The growth of the fronds is basal, while that of the stipe is terminal. Mature specimens of this species in the Puget Sound region reach, under favorable conditions, a length of 30 to 70 feet and weigh from 18 to 35 pounds.

Large Nereocystis plants as seen in the water are usually darker in color than Macrocystis plants. Seamen locally speak of the former as black kelp and of the latter as brown kelp.

Macrocystis also attaches itself to rocks, and its holdfast is, in a general way, similar to that of Nereocystis. From this holdfast there arise, however, several stipes. Each of these stipes has numerous leaf-like fronds throughout much of its length. These fronds occur singly and are from 12 to 15 inches apart. The fronds reach a length of from 12 to 15 inches. Each frond has at its base a hollow pear-shaped body which tends to buoy the plant up in the water. These floats are from 2 to 3 inches long, and an inch or less in diameter. At low tide a considerable portion of the plant is thus kept at the surface of the water. The longest stipe found by the writer in the Puget Sound region measured 40 feet in length.

Egregia has several stipes arising from a large holdfast which finds attachment to rocks a little below extreme low tide. The stipe is flattened and leathery, and sometimes reaches as great a length as 20 feet in this region. Two kinds of outgrowths appear along the edges of this frond. Both are more or less leaf-like. One kind has at its base an elongated bladderlike float a little smaller than that of Macrocystis. The flattened leaf-like portion of this structure is frequently worn off by the beating of the plant upon the rocks by heavy waves, so that nothing but the float remains. The other outgrowths are simply leaf-like. They are 2 or 3 inches long and are very narrow.

As will be seen from the accompanying maps, the principal kelp beds of this region are in the Strait of Juan de Fuca and along the shores of the islands lying to the north of it. The beds from Port Townsend to Olympia are much scattered and are not of very great size or density. Since the best beds are in the most exposed situations, they offer more difficulty in harvesting than the smaller beds do.

REPRODUCTION OF THE KELPS COMPOSING THESE BEDS.

All three of the kelps referred to above are reproduced by spores. The spores of Macrocystis are borne in regions of the fronds known as soral patches. These regions are slightly thicker than the other portions of the frond and also differ from them in color. The writer has found Nereocystis to be producing spores abundantly as early as June 20 and as late as September 28. Nereocystis is for practical purposes an annual plant. Quite probably the life of some individuals is more than a year.

The spores of Macrocystis are produced on fronds situated near the base of the plant. Those of Egregia are on the narrow leaf-like outgrowths along the edges of the stipe. Both of these species are evidently perennial. Macrocystis is reported to have the power of regeneration. That is, new stipes grow from the base of the plant and replace old ones that are cut away.

THE ANNUAL CROP OF KELP IN THE PUGET SOUND REGION.

An estimate of the number of tons of kelp in the various beds of Nereocystis has been made by determining the weight of individual plants, the number of plants per square foot of area, and the number of square feet in the bed. In good kelp beds the individuals weigh from 18 to 35 pounds, and there are from three-fourths to $1\frac{1}{4}$ plants per square foot. In smaller beds the plants may weigh as little as 10 pounds and there may be as few as one-fourth or less to the square foot. As a result of the investigations of 1911 and 1912, the following estimate of kelp in the Puget Sound region is made. This is mainly Nereocystis, but some Macrocystis and a little Egregia will be found with it as noted above. This estimate is very conservative.

TABLE XXV.—*Estimate of amount of kelp in Puget Sound region as result of investigations of 1911 and 1912.*

	Tons.
American shore of the Strait of Juan de Fuca	260,000
Smith Island	100,000
San Juan Island and small islands near its shore	10,000
Other islands of the San Juan group	9,000
Admiralty Head to Point Roberts	8,000
Puget Sound from Port Townsend to Olympia	3,000
	390,000

It is to be borne in mind that the kelp estimated above is mainly Nereocystis, which is an annual plant. If not harvested, the plants drift loose during the winter, so that very few remain at midwinter.

The amount of the crop evidently varies a little from year to year. The principal factor in this seems to be heavy westerly winds which tear the plants loose. There was a fairly good kelp bed on the ledge

at the north side of Protection Island in 1911, and seafaring men familiar with the region report that kelp is usually abundant there. In September, 1912, however, only scattering plants were found. There seems to be less annual variation in the amount of kelp in the beds in more protected places.

DRIFT KELP.

When kelp is torn loose by the waves considerable quantities of it drift on shore. Drift kelp is probably more abundant on the west coast of Whidbey Island than elsewhere in the region. This shore is exposed directly to the tidal currents sweeping in from the strait. In one case in 1912 a fish trap on this shore was almost completely destroyed by the great mass of kelp drifted against it. It does not seem to the writer that these masses of drift kelp are of commercial importance. The kelp in its attached condition is so abundant that it seems much easier to get it from the beds than to gather it from the beach.

METHODS OF HARVESTING.

It still seems to the writer that the suggestion in regard to harvesting offered in his article in Senate Document No. 190 is the most feasible one; that is, to provide a cutting bar attached by suitable device to the front of a barge. This device should be such that the depth of the bar below the surface of the water would be from 6 to 10 feet. Some means should be devised of rolling the kelp onto the barge for transportation to the factory.

THE USE OF KELP FERTILIZER.

It seems that a mixture of the potash fertilizer from kelps with fish guano obtained from refuse from the salmon canneries, or prepared from coarse fish, such as the dogfish, would produce a good fertilizer. The fish guano would supply phosphates and nitrogen, while the kelp would supply the potash. The kelp might be used by simply drying and grinding it. This would yield no by-products. It would seem that several by-products of Nereocystis and Macrocystis are worth consideration. Among these are iodine and adhesive substances.

POTASSIUM IN PLANTS.

The distribution of potassium in plants has been studied by MacCallum[1] and Weavers.[2] Their work has been reviewed by Crocker.[3]

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[1] MacCallum, A. B., Science N. S. 32 : 449–458, also 492–502. 1910.
[2] Weavers, Th., Recueil des Travaux Bot. Neerl. 8 : 289–332. 1911.
[3] Crocker, William, Botanical Gazette 53 : 362. 1912.

The following notes are based largely on Crocker's review. The method used mainly is that of treating the tissues with sodium cobaltinitrite, then washing them thoroughly and afterwards treating them with ammonium sulphide. Potassium was found in all groups of plants except the Cyanophyceæ. The nucleus and chloroplast were found to be potassium-free, while the vacuole was found to be rich in potassium and the cytoplasm was found to contain considerable. It has been suggested that these reagents are not capable of showing the localization of the potassium in the cell and that the apparent localization was probably due to precipitation determining the concentration gradients in both the reagent and the potassium salt. Practically all the potassium found in the plant cell can be dissolved out of the dead cell with either water or 50 per cent alcohol. This has been made the basis for the belief that the element exists in plants in the form of inorganic salts and not as a part of the protoplasmic organic constituents. It seems probable that potassium in the growing point is connected with protoplasmic construction, while in the vacuole it aids in the production of osmotic pressure.

OWNERSHIP OF BEDS.

On October 12, 1911, the Solicitor of the United States Department of Agriculture furnished an opinion to the Chief of the Bureau of Soils, stating:

> Jurisdiction over the shores of the sea below the line of high tide and for a distance of 1 marine league, or 3 geographical miles, out to sea from the line of low water is wholly within the respective States, subject to the paramount right of the Federal Government to regulate commerce and navigation.

In 1912 two questions were raised in regard to the ownership of Puget Sound beds: (1) Does the State of Washington own the bed adjacent to Smith Island, which is a lighthouse reserve and the property of the United States? (2) Has the State of Washington parted with its title to any kelp beds in granting to private owners title to second-class tide lands? These two questions were submitted to the attorney general for the State of Washington. His opinion, furnished May 27, 1912, is that the title to the kelp adjacent to Smith Island is in the State and that "any person may lawfully appropriate such seaweed." In regard to the second question, second-class tide lands are those "extending to extreme low tide," and "the right to take seaweed upon these lands is in the grantee of the State."

The kelp that constitutes practically all of the beds of the Puget Sound region is *Nereocystis luetkeana* (the bladder kelp). *Macrocystis pyrifera* is of some importance in the beds of the western portion of the Strait of Juan de Fuca. Neither of these kelps grows

above extreme low tide, consequently there is no private ownership of either of these species along the shores of the State of Washington.

From the above opinion it appears that the title to all kelp beds in Puget Sound that appear at present to have any commercial value (with the exception of the bed on the Alden Bank, which seems to be outside of the 3-mile limit) is in the State of Washington. There was comparatively little kelp found on the Alden Bank when the writer visited it in August, 1911.

IV. THE KELP BEDS OF SOUTHEAST ALASKA.

By T. C. Frye.

INTRODUCTION.

AREA COVERED.

This report on the kelps covers the shores of Alaska from Dixon Entrance northward to Chatham Strait, including both shores of the latter. The territory covered is roughly 85 miles wide by 300 miles long, or an area of about 25,500 square miles, which is about the same as the combined area of New Hampshire, Vermont, and Massachusetts. The region is an archipelago whose islands vary from mere rocks to areas about the size of Delaware. The channels between these islands range from narrow passages to bodies of water 15 miles in width. The extent of shore line is prodigious in comparison to the area of the land on account of the numerous small islands and the vast number of indentations. The length is estimated at 7,000 miles, of which about 6,000 miles were actually examined by the party. The long, deep bays and inlets of the mainland were often too unpromising as kelp regions to warrant exploration.

PURPOSE AND ORGANIZATION OF THE PARTY.

The party was sent out by the Bureau of Soils of the United States Department of Agriculture to locate the kelp beds of Alaska and estimate the amount commercially available. The personnel of the party was as follows:

Dr. T. C. Frye, professor of botany in the University of Washington, in charge of the party; Dr. R. B. Wylie, professor of botany in the University of Iowa, botanist; Mr. Dean Waynick, senior in the University of Washington, photographer and chemist; Mr. A. S. Foster, Dungeness, Wash., a taxonomic botanist.

The party left Seattle May 1, 1913, and returned September 15, thus being out 4½ months.

The work was done in motor boats of about 30 horsepower and 45 to 60 feet long, a form of craft very commonly in use by the fishermen of Alaska.

MANNER OF WORKING.

In doing the work the boat slowly skirted the shores, usually at a distance of 20 to 400 yards from the margin of the kelp beds. With an offshore wind or quiet water the boat could be guided right along the edge of the kelp beds, but with a heavy sea or on-shore winds the work had to be done at a greater distance. Occasionally, when it was considered unsafe for a boat to approach a bed close enough for satisfactory observation, the bed was visited in a rowboat. One or two men were constantly on the highest accessible portion of the boat looking with binoculars for kelp beds; observing the position of the boat with relation to the topographic features of the country and locating the same on the maps; observing the width, length, and form of a kelp bed, and sketching it on a map; and observing the species, density, and availability of the kelp. At first it was the intention actually to measure the width of the beds with a tape, but it was soon found that it would take at least five times as long to do the work in that manner, while very little would be gained because the irregularity of the beds would in any case have left the average width to the judgment of the eye.

On trips with the rowboat observations were made on the economic kelps with regard to their size, age, weight, vigor, reproduction, and other phenomena bearing upon the successful utilization of the product and the perpetuation of the beds.

Considerable photographic work was done to illustrate conditions and to show the various kinds of kelps. Observations on temperature and content of sea water were also made with a view to determining the conditions governing the distribution of the economic kelps.

WIND AND SEA.

Southeastern Alaska is a region of heavy rainfall and considerable stormy weather. The winters along the coast are mild, somewhat like those of northern Mississippi, but there are many days of cold, drizzling rain and some heavy showers and snowstorms. In May the rainy and windy days decrease in number, so that one may expect some good but cool weather. Some time in June, on the average about the middle, a period of much sunshine and calm weather begins. This usually continues until about the 1st of September, when gradually more and more stormy and rainy days occur, until by November the rainy season is again on in full force. In southeast Alaska during the longest days it is daylight from 3 a. m. to 9 p. m. Thus, during the good weather and long days much work can be done.

The storms most dreaded by Alaska seamen are those from the southeast; therefore kelp beds in regions exposed to a long sweep of

sea from this quarter are not so desirable as those exposed in some other direction. The heavy ocean swells roll in from the westward, affecting the west shores of the outermost islands. They also roll into the larger channels, so that swells are a factor in the navigation of small craft up Chatham Strait as far as the south end of Admiralty Island: up Sumner Strait to about the Calder Rocks; up Clarence Strait to Gravina Island; up Revillagigedo Channel to Mary Island. Since these swells do not necessarily move in the same direction as the local winds, these winds may produce cross swells of shorter amplitude, resulting in a sea less easily ridden by the ordinary small craft. The inner waters are fairly safe, except in case of storm, when the larger channels are too rough for small craft. In regard to its safety for small craft southeast Alaska resembles very much the Puget Sound region. There are, however, several open straits connecting with the sea instead of the single Strait of Juan de Fuca with Puget Sound, and the area is much more extensive.

OBSERVATIONS ON SEA WATER.

Apparatus was carried on board for the determination of the following points in regard to sea water: (1) Temperature, (2) density, (3) total chlorides, (4) total CO_2, (5) free CO_2, (6) semi-combined CO_2, (7) dissolved O. It was hoped that more light might be thrown on the causes of local distribution of the kelps. That they do not thrive in water of slight salinity was evident; also that quiet waters were not good regions for the large kelps seems to be established. Water temperatures of 8° to 14° C. were observed, and kelp grew in both extremes. Aside from these observations no definite relation could be traced.

A curious situation was observed near Point Couverden, where Icy Strait joins Chatham Strait. Nereocystis of good size was there found growing in the water of only 1.003 specific gravity, which is almost fresh enough to drink. A creek there empties into the strait. The volume of water naturally varies with the recent rains. When it is swollen by rains the brown peat water is traceable far beyond the beds of kelp among the islands at its mouth. However, the tide carries the current from the creek between certain islands during ebb and between others during flood. The affected kelps are therefore about half the time in almost fresh water and about half the time in almost normal sea water. It seems reasonable to doubt whether fresh water alone will kill Nereocystis quickly.

KELP ANALYSES.

The kelps analyzed were collected and dried by Mr. Waynick. The drying was first attempted in open screens with paper on them.

This did not work so very well, because the finely cut kelps would adhere to the paper in drying and thus cause a loss of material, also because the number of rainy days was so great that the sun could not be depended upon to dry the kelps before they decomposed. Most of them were therefore dried in a double cooker such as is used in households for cooking oatmeal. The source of heat was an oil stove. Macrocystis dries very much the most slowly, and it may be that the cost of drying it on a commercial scale will be found to be greater for that reason.

The per cent of substance left after air drying, or drying in cooker at a temperature of about 100° C., was determined by weighing before and after. The wet weight selected was $2\frac{1}{2}$ to $6\frac{1}{2}$ pounds. The balance was a rough one, correct only to one-sixteenth of a pound. A good balance would be ruined by salt water, and no balance, however accurate, could be depended upon for small discriminations on a rocking boat. By the method used it was found that the leaves of Nereocystis dry down to 9.2 per cent, while Nereocystis stems dry down to 7.2 per cent of the wet weight. In all cases only the upper 8 feet of stem with its bulbous top was cut to secure the stem weight, because a harvester with a cutting bar about 4 feet below the surface would cut about that length of stem. In July the leaves weigh about three times as much as the upper 8 feet of stem. In June, when the plants are young, the weight of the leaves is only about twice that of the upper 8 feet of stem. In the year-old plants the leaves weigh about five and one-fourth times as much as the upper 8 feet of the stem. The leaves thus seem to increase in weight faster than the stem, and the average cutting would result in about three or four times as much weight of leaf as stem. This is important, because the leaves and stems of Nereocystis are not equal in potash and nitrogen content, nor in their percentage of dry weights.

Table XXVI gives weights and results of analyses of kelps from southeast Alaska. These are the bases of calculations in Tables Nos. XXVII, XXVIII, XXIX, and XXX. The chemical analyses with the exception of the determinations of nitrogen, which were made by Mr. T. C. Trescot, of the Bureau of Chemistry, were made by Mr. Albert Merz, of the Bureau of Soils.

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TABLE XXVI.—*Physical and chemical data concerning the kelps of southeast Alaska.*

Station No.	Bed No.	Sampling station.	Part.	Species.	Weight wet.	Weight dry.	Solids.	Proportion of dry weight. Total salts.	K_2O.	Ash.	I.	N.	Remarks.
					Lbs.	*Lbs.*	*P.ct.*	*P.ct.*	*P.ct.*	*P.ct.*	*P.ct.*	*P.ct.*	
1	1160	Fillmore Island.	Leaves.	N...	5	.....	.....	34.38	12.74	5.12	None.	2.87	Last year's plant.
			Stem...	N...	4¼	⅜	8.3	49.44	23.88	10.66	None.	1.53	Do.
2	1150	Tongass Island.	Leaves.	N...	4½	⅜	8.3	40.10	15.12	4.34	0.07	3.06	
			Stem...	N...	3	3/16	6.2	63.74	30.12	2.76	.05	1.07	
3	605	Kashevarof Islands.	....	Al..	3¾	7/16	11.7	27.86	10.96	7.34	None.	3.25	Young.
4	230	Barrier Islands.	....	Mac.	3¼	⅜	11.5	45.76	22.48	5.22	.30	2.64	
5	71	Duke Island	....	Mac.	4¾	¾	15.8	28.62	11.49	4.07	.06	1.08	
6	383	Port Estrella.	....	Mac.	4	½	12.5	31.50	13.26	4.14	.10	1.25	
7	341	Augustine Bay.	....	Al..	5	¾	15.0	32.30	13.07	6.08	None.	2.05	
8	446	Gulf of Esquibel.	Leaves.	N...	5½	9/16	10.2	57.26	19.63	3.46	None.	1.04	
			Stem...	N...	2½	3/16	7.5	48.86	27.02	3.22	None.	.81	
9	524	Davidson Inlet.	Leaves and stem.	N...	6	9/16	9.4	53.59	22.75	4.28	.03	1.01	Young.
10	550	Shipley Bay	....	Al..	3½	7/16	12.5	27.18	10.65	12.12	None.	2.43	
11	597	Kashevarof Passage.	....	Al..	4	9/16	14.1	26.82	11.83	8.80	Tr.	2.44	
12	587	Red Bay...	....	Al..	3	½	16.7	19.76	8.60	5.48	None.	2.87	
13	567	Shakan Bay	Leaves.	N...	4½	⅜	8.3	44.92	20.12	3.64	.06	1.85	
14	737	Point St. Albans.	....	Al..	5	11/16	13.7	27.46	10.90	8.18	None.	2.80	
			Leaves.	N...	5	½	10.0	.....	.....	.....	.....	.....	Last year's plant.
			Stem...	N...	6½	7/16	6.7	.....	.....	.....	.....	.....	Do.
15	None	Wrangell Strait.	....	F...	4	¾	18.7	17.52	3.51	5.44	None.	1.18	Floating masses.
	882	.....do......	Leaves and stem.	N...	8½	⅝	7.3	51.24	21.61	5.25	.09	1.65	Normal attached plants.
			Leaves.	N...	3¾	.....	.....	44.40	17.67	4.98	.10	2.01	Loose plants.
			Stem...	N...	3¾	.....	.....	53.54	24.80	3.68	.03	.98	Do.
16	818	Security Bay.	....	Al..	5	⅝	12.5	26.48	9.02	15.08	None.	3.30	Covered with Bryozoans.
17	583	Point Baker	....	Al..	4	.....	.....	21.80	8.63	5.96	None.	2.68	Clean.
18	893	Whitney Island.	....	Al..	4	.....	.....	19.46	6.92	6.58	Tr.	2.69	
19	990	Point Gardner.	....	Al..	4	.....	.....	19.84	7.30	6.92	None.	2.19	
			Leaves.	N...	3¾	.....	.....	.....	.....	.....	.....	.....	
			Stem...	N...	4	.....	.....	.....	.....	.....	.....	.....	
		Calculations.	Stem and leaves.	N...	.....	.....	8.9	45.27	19.14	4.48	.04	1.92	Stems and leaves mixed in proportion as in commercial cutting.
			Leaves.	N...	.....	.....	9.2	42.09	17.05	4.31	.05	2.16	Averages.
			Stem...	N...	.....	.....	7.2	56.39	26.45	5.07	.02	1.09	
				Mac.	.....	.....	13.27	35.29	19.08	4.48	.15	1.66	
				Al..	.....	.....	13.74	24.64	9.71	8.25	.00	2.67	

Tables XXVII and XXVIII show about what may be expected of 1,000 tons of fresh kelp cut in the fall in southeast Alaska.

TABLE XXVII.—*Estimated production of dry kelp, K_2O and N, from 1,000 tons of Nereocystis.*

Substance.	Leaf.	Stem.	Total.	Remarks.
	Tons.	*Tons.*	*Tons.*	
Wet kelp..........	775	225	1,000	Counting 3½ times as much leaf as stem.
Dry kelp..........	71	16	86	Leaves average 9.2 per cent dry; stems 7.2.
K_2O..............	12	4	16	Leaves 17.05 per cent K_2O; stems 26.45 per cent K_2O.
Nitrogen..........	1.54	0.17	1.7	Leaves 2.16 per cent N; stems 1.09 per cent N.

TABLE XXVIII.—*Estimated production of dry kelp, K_2O and N, from 1,000 tons of Alaria and of Macrocystis.*

Substance.	Macrocystis.	Alaria.
	Tons.	*Tons.*
Dry kelp	132	137
K_2O	25.3	13.3
Nitrogen	2.2	3.6

To test whether loose plants lose salts by leaching, Nereocystis plants were torn loose and tied fast to other plants in a strong current. The plants were tied in Wrangell Strait at a point where the tidal current would average about 4 miles per hour at flow and ebb. They were left there 11 days, then cut and dried for chemical analysis. Their analysis compared with normal attached kelps from the same point is as follows:

TABLE XXIX.—*Comparative analyses of attached and loose Nereocystis.*

Sample.	Total salts.	K_2O.	Ash.	I.	N.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Attached	51.24	21.61	5.26	0.09	1.65
Loose	48.97	21.23	4.33	.06	1.49

While the loose kelp shows slightly less salts, the difference is not greater than could easily be due to the differences in analyses of individual kelps from the same bed. It is not likely that leaching occurs to any considerable extent until the plants are dead; and cutting does not cause death at least for weeks, so long as the plants are kept immersed in good, fresh sea water. In fact, kelps will grow as well floating as attached. The disadvantage of floating plants is the probability of their being washed or blown ashore like beach wood. Observe their holdfast formation in Plate XXIII. The retention of the salts is likely due to the diosmotic properties of the living protoplasm of the cells. The sugar and red coloring matter in beets are retained in the cells in the same way until the protoplasm is killed, as, for example, through cooking or approaching decomposition.

The following table shows what may be expected of 100 acres each of Nereocystis, Macrocystis, and Alaria of medium density, based upon our estimate of tonnage and the figures obtained in desiccation and chemical analysis:

TABLE XXX.—*Estimated products from 100 acres each of medium density of the three commercial kelps.*

Species.	Wet.	Dry.	K_2O.	N.
	Tons.	*Tons.*	*Tons.*	*Tons.*
Alaria	1,690	232	22.5	6.2
Macrocystis	9,700	1,287	245.6	21.4
Nereocystis	33,800	3,155	587	62.4

OBSERVATIONS ON THE IMPORTANT VARIETIES OF KELP.

NEREOCYSTIS.

Nereocystis is generally recognized to disappear in the winter and to reappear in the spring, each year's crop being formed from minute seedlike bodies called spores. The individual plants, like wheat, when once pulled up or cut do not again appear.

On the way up to Alaska during the first week of May great numbers of young Nereocystis plants were observed afloat. These averaged about 3 feet of stalk and about 2½ feet of leaves. Most of them had holdfasts, from which one is led to infer that they started on a substratum from which they were easily loosened. Naturally the spores, like seeds, will germinate under suitable climatic conditions, regardless of the substratum. As the kelp plants increase in size their air spaces increase and thus their pull on the substratum as well. Therefore in time all will be torn loose which have not attached to a firm bottom. Undoubtedly in the spring great numbers are thus loosened.

The first visit to a kelp bed was made on May 11, to bed No. 2, at the north end of Gravina Island. The kelp plants then had an average length of stalk of about 20 feet and an average diameter of about 1 inch a foot below the bulb. The leaves averaged about 10 feet long. The tide was very low, but even then less than half the plants reached the surface. However, already about 2 per cent, and always the larger ones, were reproducing. A few days later, on May 16, in bed No. 1150, near Tongass Island, a large number of kelp plants were measured. They gave the following average: Number of leaves 30, leaf length 13 feet, stem length 27 feet, total length 40 feet. At this time the leaves with upper 8 feet of stem weighed on the average about 6 pounds per plant. At high tide very little yet showed on the surface at that time.

It was not until about June 15 that the plants were large enough to appear on the surface at high tide in sufficient quantity to enable one to estimate the tonnage of a bed with confidence. (For such beds see Pls. XXIV, XXV.) Even then the leaves and upper 8 feet of stem on the average weighed only about 13 pounds.

About the 1st of July the average weight of plants was about 15 pounds, and by the 20th of August about 25 pounds. The wisdom of cutting kelp before the 1st of July seems doubtful, aside from the fact that we are not sure how soon it has produced enough spores for seeding.

It was found that all the plants of Nereocystis do not die during the winter. The old plants can easily be distinguished during May and June on account of their large size, the large amount of seaweed growing on their stems as a support, and often by the loss of many of the leaves. On the average the leaves and upper 8 feet of the stem

of these old plants gave the following weights: Stem, 10 pounds; leaves, 60 pounds; total weight, 70 pounds. The largest individual plant weighed 127 pounds and had a leaf surface of about 754 square feet. Such old plants are found usually in fresh sea water on deep rocks, and, as a rule, have rather little of their stem floating on the surface. Wherever found these old plants were reproducing prolifically. While they are not abundant enough to be of commercial importance, they are of interest as indicating that likely plants of Nereocystis gain steadily in weight up to late winter, if not throughout their life. Therefore, the later the cutting, prior to the time when the beds begin to be torn away by whatever cause, the greater the tonnage.

In May and early June many Nereocystis plants were noticed with the bulbs bleached and somewhat shrunken on the upper side. It was at first thought this might be due to frost. Since, however, none of the old kelps showed such conditions, it was concluded that the affected young kelps were sun scalded when first they appeared on the surface. Approximately 1 per cent of the plants were thus affected.

Nereocystis is found throughout the area covered where there was any commercial kelp at all. In the southern part, in the outer waters of the archipelago, it is often mixed with Macrocystis. In the northern part it is often mixed with *Alaria fistulosa* (Pls. XXVI, XXVII, XXVIII). But no place was found in which the three grew to any considerable extent in the same bed. The fresher waters seem to support the largest and most vigorous plants of whatever species. In the inner waters the plants are smaller and often lighter in color.

MACROCYSTIS.

Macrocystis (Pls. XXIX and XXX) is limited to the Duke Island region and the region west of Prince of Wales Island. It has never been reported north of Sitka. It is not found in all the beds, and when present is usually exclusive over the area ~~where~~ found. Aside from the fact that it doesn't seem to stand violent churning of waters as well as Nereocystis it is not clear just what determines its local distribution. A few soundings in beds of Macrocystis showed 20 to 35 feet of water, a depth similar to that in which Nereocystis grows.

Surprisingly little kelp of any kind was found along the southern part of Dall Island. This we surmise is due to the limestone rock. Certainly the sea water is fresh enough.

ALARIA.

Alaria fistulosa is a conspicuous feature of the commercial kelp beds, mostly in Sumner Strait and northward (Pls. XXXI, XXXII, XXXIII). It was observed, however, as far south as Augustine Bay

on Dall Island. It is a perennial plant composed of a single large blade with a midrib, the blade narrowing gradually at base until it merges into the rib in a growing region 1 to 3 feet from the base of the plant. Below the growing region is a foot or so of solid stem a little larger than a lead pencil. About 6 or 8 inches from the base of this stem is a bunch of small leaves which bear the spores for the reproduction of the plant (Pls. XXXIV, XXXV, XXXVI, XXXVII). At the base of the stem is a bunch of holdfasts by means of which the plant is fastened to the rock (Pl. XXXIV). Since the growing region is at the base of the blade the upper portion of the blade is the older, and is the one which will be cut. Cutting will thus not likely seriously affect the growth of the plant, nor its reproduction other than such harm as may be done by the cutting off of a large part of the starch-forming portion of a plant.

The upper end of the blade is usually frayed, often partly decomposed (Pls. XXXIV, XXXVIII). Often it is nearly covered with a fixed animal, *Membraniphora membranacea*, belonging to the group Bryozoa. The dry weight and ash constituent are likely to be increased when the bryozoa are very abundant, since they have a cartilaginous shell and will make up some of the weight. The weight of this kelp per acre is small in comparison with Nereocystis and Macrocystis since the blades are very thin. In potash content it is low, in the per cent of dry material it is about the same as Macrocystis; in nitrogen content it exceeds both Nereocystis and Macrocystis.

While it was found to reach a length of over 60 feet within our area, it does not seem to be able to grow in as deep water as can Nereocystis. Neither does it seem to be able to stand violent wave action like Nereocystis. Therefore when it grows with Nereocystis along a shore as a fringe it nearly always forms the inner portion of the fringe, and Nereocystis the outer. No soundings showing more than 30 feet were made in beds of Alaria.

The first beds were met with on May 30. At that time the length of the plants varied from 18 to 41 feet, with an average of 27 feet; the width at widest part averaged about 9 inches; the weight averaged about 2½ pounds each for the whole plant. On July 22 the same bed showed the plants to be 25 to 60 feet long, with an average of about 40 feet, while the average width of the leaves was about 16 inches at the widest part and the average weight about 6½ pounds. Whether Alaria disappears in winter or not was not determined. It is surmised that the kelp disappears from the surface during the winter, but that the base and some of the lower part of the blade remain. The average length of *Alaria fistulosa* in July and August is about 40 feet, of which about one-fourth is horizontal on the sur-

face of the water. Cutting with a reaper such as is used in California kelp beds would cut in the neighborhood of 20 feet of the upper part of the plant. The average width at the widest part of the blade is about 17 inches during the same months. The extreme in length found was 63½ feet and that in width 4½ feet. The floating of the blade is due to the hollow mid vein. The hollow is plugged every 1 to 4 inches, so it is a series of tubular chambers.

On May 30 the small blades near the base which form the spores were small or wanting entirely. None were seen over 5 inches long, and none were found in which we could be certain that spores were formed. However, on July 22 the spore leaves were 6 to 12 inches long and undoubtedly reproducing. As in Nereocystis, the wisdom of cutting before July 1 is doubtful; but cutting too early would not do near the damage that would be done by the early cutting of Nereocystis.

Like Nereocystis, *Alaria fistulosa* flourishes best in fairly fresh sea water. It is wanting in the inner canals and inlets. It is not found on shores exposed to the breakers of the open sea. Its greatest enemy seems to be the bryozoan (*Membraniphora membranacea*).

FUCUS.

Fucus (Pl. XXXIX) is a conspicuous feature in many of the beds. It seems to flourish floating much more commonly than on Puget Sound and southward, and much more so than do Nereocystis, Macrocystis, and Alaria. Acres of it are sometimes seen so dense that it is hard to tell whether it is a bed of the other kelps or not without getting close to it. (Pl. XL.) When it gets stranded on shore it merely awaits the next tide to lift it again. Exposure to the sun and air does not kill it so readily as the other commercial kelps, since it holds water in its tips through the great amount of slime there. The cooler weather likely is the cause of its much greater abundance than farther south. This Fucus (Rockweed) sometimes drifts into the kelp beds in great quantity and thus becomes a factor from the commercial standpoint.

Together with Fucus there is considerable driftwood in the beds. This will likely give some trouble with machinery for cutting kelp into pieces. The reaper is less likely to give trouble on this account.

EXPLANATION OF TABLE OF BEDS (TABLE XXXII).

Bed number.—The beds were numbered consecutively. Occasionally a few small beds are grouped under one number, either because they were close together or because it would be less likely to lead to confusion.

Sheet.—The map of southeast Alaska was cut into suitable sections, each of which forms one of the kelp maps accompanying this paper.

These maps are lettered from C to G, inclusive, the letters being given in the column headed "Sheet."

Vicinity.—This is usually the nearest, named, natural feature of the country. It is intended to give the location of a bed as nearly as any single word or name can do it. The island or point mentioned is merely the nearest, named object; the bed is not necessarily on it.

Latitude and longitude.—These are to give the location by points on the map. The location is accurate only to degrees and minutes. Naturally a large bed or a very long one may be in part at a considerable distance from the point located. Naturally, also, the point located may entirely miss a small bed somewhat.

Kind.—This refers to the species of kelp composing the bed. Three kinds were found in sufficient quantity to indicate: Al=*Alaria fistulosa* (Stringy kelp); Mac=*Macrocystis pyrifera* (California kelp); and N=*Nereocystis luetkeana* (Bull kelp). When two kelps compose a bed, the proportion of each is estimated in tenths. These are tenths of the area estimated to be occupied by each species, and not tenths of the tonnage.

Density.—The beds were grouped into six different densities, depending upon the amount of surface which remained unoccupied by the kelps. But since density and weight per unit area are proportional it was possible by the cutting of measured areas of different density to secure a table of weights by which the different densities could be expressed. And, conversely, it was possible to check our judgment of densities by cutting and weighing a portion of a bed. Naturally the density varies with the species of kelp. The following is the table of densities thus worked out and used in the work in southeast Alaska. The weights are pounds per square yard.

TABLE XXXI.—*Weights per square yard for the three kelps in the six densities.*

Symbol.	Meaning of symbol.	Nereocystis.	Macrocystis.	Alaria fistulosa.
		Pounds.	*Pounds.*	*Pounds.*
VT	Very thin	[1] 55	[1] 22	[1] 2.8
T	Thin	56 to 111	23 to 34	2.9 to 5.4
M	Medium	112 to 167	35 to 44	5.5 to 8.2
MH	Medium heavy	168 to 224	45 to 54	8.3 to 10.9
H	Heavy	225 to 280	55 to 64	11 to 13.6
VH	Very heavy	[2] 281	[2] 65	[2] 13.7

[1] Or less. [2] Or more.

Length.—In short beds the length was estimated by comparison with trees, boats, or other objects. By judging measured distances whenever possible the eye was kept in training. The limits of long beds could usually be determined by irregularities of the coast line, and thus directly measured on the map. Occasionally large beds at some distance offshore, or long beds on a very uniform coast line,

were measured by timing the boat at a fixed speed and allowing for current.

Width.—Nearly always the width was estimated with the eye. At first it was attempted to measure beds, but it was soon seen that it would take at least five years to cover southeast Alaska in that way. Further it was found that on account of the great irregularity of the beds much was left to the judgment of the eye, even after the use of the tape measure. Large beds occasionally could be drawn from point to point on the map, and could then be measured there; sometimes the width was determined by the time and speed of the boat.

Area.—This was figured from the length and width.

Estimated tonnage.—The tonnage varies with the time of the year and somewhat in different years, just as does a crop of corn fodder. Kelp is a growing crop, and different years are not equally favorable for its growth nor are they equally early. Even the perennial forms in these northern waters undoubtedly grow much less in winter than in summer, and thus would be a light crop if cut early in the spring. The estimated tonnage, therefore, must be based upon a certain time of year. Those given are for about the middle of August, and, of course, for the year 1913.

The tonnage is an estimate based on the density and the weight of kelp secured by the cutting of occasional portions of beds of different densities. This is expressed in tabular form under "Density."

Availability.—Some beds are in quiet waters; others are exposed to the ocean swells. Some are free from rocks which would affect vessels of 5 to 7 feet draft; others are thickly studded with them. Thus the beds are not all equally desirable from the standpoint of cutting. Taking into account both these factors, the beds have been roughly grouped into four grades of availability or desirability, using the letters A, B, C, and D. "A" beds are the most desirable, and "D" beds the least. This does not take into consideration the density nor size of the beds.

Nearest deep harbor.—By this is meant the nearest place where there may be sufficient shelter for a factory on water deep enough to permit the call of ocean-going vessels.

Nearest shelter.—In the cutting of kelp, scows and motor boats drawing 6 feet or less of water will likely be used. In case of storm, or over night, the cutting crew may wish shelter as near the bed as possible. The places mentioned are those where it is likely such shelter from storm could be found.

Fish industry at harbor.—Since it is possible that the same machinery may be used for drying kelp as well as fish scrap, the location of fish industries may have some bearing on the desirability of a har-

bor for a factory site. Wherever there is a fish industry at the harbor it is indicated.

In this column C=cannery; F=fertilizer factory; S=saltery or mild-cure plant.

THE KELP MAPS.

With maps on the scale of $\frac{1}{200,000}$ it was found necessary to exaggerate the width of narrow beds to make them show the colors well. It takes a bed 100 yards wide to make a good line along a shore on that scale. The width is, however, rather under than over estimated in the table of beds. Wide beds have the width mapped to scale.

AREA AND PRODUCTION OF KELP IN SOUTHEAST ALASKA.

The total amount of the kelp crop in the area included in this report is estimated to be 7,833,000 tons. This includes about 33,000 tons not given in the table of beds (Table XXXII), but appearing on the maps as mere dots of color. These small patches are not closely associated with beds, nor themselves large enough to be of commercial importance alone. The availability of this total is about as follows:

	Tons.
A	2,880,000
B	3,250,000
C	1,603,000
D	100,000
Total	7,833,000

The total area is estimated to be a little over 45,300 acres, which is about 70 square miles.

LOCATIONS FOR FACTORIES.

In our estimation the eight best centers for a kelp industry in the region included in this report are the following, in the order of desirability: (1) Port McArthur, near the south end of Kuiu Island; (2) Shakan Bay, on Sumner Strait; (3) Tyee, near Point Gardner; (4) Duke Island, possibly inside the Vegas Islands; (5) Saginaw Bay, at the north end of Kuiu Island; (6) Warren Cove, on Warren Island; (7) Barrier Islands, between Cape Chacon and Cape Muzon; (8) Bay of Pillars, on Chatham Strait.

TABLE XXXII.—*Location, area, and tonnage of the surveyed kelp beds of southeast Alaska.*

Bed. No.	Sheet.	Vicinity.	Latitude.		Longitude.		Kind.	Density.	Length.	Width.	Area.	Estimated tonnage.	Availability.	Nearest deep harbor.	Nearest shelter.	Fish industry at harbor.
			°	′	°	′			Yards.	Yards.	Acres.	Tons.				
1	G	Guard Island	55	26	131	52	N	M	500	2	0.20	70	C	Ward Cove	Vallenar Point	C
2	do	Vallenar Rocks	55	25	131	51	N	T	1,000	20	4.13	840	C	do	do	C
3	do	South Vallenar Point	55	22	131	52	N	M	5,250	6	6.50	2,690	B	do	Vallenar Bay	C
4	do	do	55	22	131	53	N	VH	300	25	1.55	1,156	A	do	do	C
5	do	West side Gravina Island	55	17	131	50	N	VT	18,900	4	15.62	3,175	B	Clover Bay	do	
6	do	do	55	11	131	49	N	M	3,100	8	5.12	1,736	B	Metlakatla	Dall Bay	C
7	do	do	55	09	131	48	N	M	1,100	4	.90	308	C	do	do	C
8	do	Dall Head	55	09	131	47	N	VT	1,500	4	1.24	84	C	do	do	C
9	do	do	55	08	131	46	N	M	1,350	20	5.58	1,890	C	do	do	C
10	do	do	55	07	131	45	N	VT	1,050	530	114.98	7,700	B	do	do	C
11	do	Bronaugh Islands	55	07	131	44	N	M	4,700	15	14.57	4,935	B	do	do	C
12	do	Point McCartey	55	07	131	43	N	VT	4,600	175	166.32	14,875	B	do	do	C
13	do	do	55	07	131	41	N	M	100	60	1.24	420	A	do	do	C
14	do	Dall Bay	55	08	131	44	N	H	1,400	10	2.89	1,765	C	do	do	C
15	do	do	55	09	131	43	N	M	1,900	8	3.14	974	B	do	do	C
16	do	do	55	09	131	44	N	M	160	15	.50	168	B	do	do	C
17	do	Seal Cove	55	10	131	43	N	M	4,175	10	8.63	2,922	B	do	Seal Cove	C
18	do	Bostwick Inlet	55	13	131	41	N	MH	1,150	10	2.38	1,128	B	do	Bostwick Inlet	C
19	do	Blank Point	55	15	131	39	N	MH	100	10	.20	98	A	Ketchikan	Blank Inlet	C
20	do	do	55	16	131	40	N	M	1,325	7	1.92	650	B	do	do	C
21	do	Blank Islands	55	17	131	38	N	M	4,000	3	2.48	560	C	do	Annette Bay	C
22	do	Gravina Point	55	17	131	37	N	M	2,375	4	1.94	665	B	do	do	C
23	do	Pennock Island	55	18	131	36	N	M	800	5	.83	280	B	do	Ketchikan	C
24	do	do	55	19	131	39	N	H	1,175	4	.97	531	A	do	do	C
25	do	Pennock Reef	55	20	131	39	N	MH	75	75	1.16	553	A	do	do	C
26	do	Tongass Narrows	55	23	131	44	N	M	125	20	.52	175	B	Ward Cove	Ward Cove	C
27	do	Race Point	55	17	131	34	N	MH	300	20	1.24	588	B	Ketchikan	Annette Bay	C
28	do	Walden Rocks	55	16	131	36	N	VH	1,381	11	3.14	1,305	B	do	do	C
29	do	do	55	15	131	36	N	M	300	10	.62	210	B	do	do	C
30	do	Walden Point	55	15	131	35	N	T	3,600	16	11.90	2,652	B	do	do	C
31	do	do	55	14	131	36	N	H	100	25	.52	316	B	Metlakatla	do	C
32	do	Sylburn Harbor	55	12	131	36	N	T	3,200	8	5.29	1,226	B	do	Sylburn Harbor	C
33	do	Dreist Point	55	11	131	36	N	M	2,075	20	8.59	2,903	C	do	do	C
34	do	do	55	10	131	35	N	M	200	13	.54	182	B	do	do	C
35	do	Port Chester	55	09	131	35	N	M	300	40	2.48	840	B	do	Metlakatla	C
36	do	do	55	09	131	36	N	M	1,525	8	2.52	854	B	do	do	C
37	do	do	55	08	131	36	N	M	2,000	10	4.13	1,400	C	do	do	C
38	do	Kelp Rocks	55	09	131	39	N	H	380	50	3.93	2,370	A	do	do	C
39	do	Warburton Island	55	08	131	37	N	M	300	20	1.24	420	B	do	do	C
40	do	Metlakatla	55	07	131	36	N	M	2,500	25	12.91	4,364	B	do	do	C
41	do	Smuggler Cove	55	05	131	36	N	MH	925	7	1.34	637	B	do	do	C

TABLE XXXII.—*Location, area, and tonnage of the surveyed kelp beds of southeast Alaska*—Continued.

Bed No.	Sheet.	Vicinity.	Latitude.	Longitude.	Kind.	Density.	Length.	Width.	Area.	Estimated tonnage.	Availability.	Nearest deep harbor.	Nearest shelter.	Fish industry at harbor.
			° ′	° ′			*Yards.*	*Yards.*	*Acres.*	*Tons.*				
42	G	Smuggler Cove	55 04	131 37	N	MH	1,250	20	5.17	2,460	C	Metlakatla	Metlakatla	C
43	do	do	55 05	131 38	N	MH	180	25	.93	444	A	do	do	C
44	do	Hid Reef	55 04	131 40	N	M	1,280	50	13.22	4,480	A	do	do	C
45	do	Canoe Cove	55 03	131 37	N	M	200	40	1.65	560	C	do	do	C
46	do	do	55 02	131 39	N	MH	1,180	100	24.38	11,566	C	do	do	C
47	do	Point Davison	55 01	131 36	N	VT	7,800	350	564.05	20,000	B	Tamgas Harbor	Tamgas Harbor	
48	do	Sextant Point	55	131 34	N	VT	1,500	400	123.97	8,400	B	do	do	
49	do	Moss Point	55 01	131 33	N	M	275	40	2.27	770	A	do	do	
50	do	Grass Rock	55 02	131 32	N	VT	200	100	4.13	280	B	do	do	
51	do	Survey Point	55 01	131 30	N	M	1,300	4	1.07	354	B	do	do	
52	do	do	55 01	131 27	N	H	3,696	10	7.64	4,669	A	do	do	
53	do	Annette Point	55 01	131 24	N	MH	1,230	10	2.54	1,106	A	do	do	
54	do	Ajax Reef	55	131 27	N	M	100	75	1.55	524	B	do	do	
55	do	Harris Island	55	131 32	N	M	810	5	.84	283	B	do	do	
56	do	Hotspur Island	54 59	131 31	N	M	500	5	.52	175	B	do	do	
57	do	Werlick Island	54 58	131 30	N	M	4,250	13	11.42	3,851	B	do	do	
58	do	Hotspur Island	54 58	131 29	N	M	1,850	6	2.17	777	B	do	do	
59	do	do	54 59	131 29	N	M	400	5	.41	140	B	do	do	
60	do	do	55	131 31	N	M	130	20	.54	182	B	do	do	
61	do	Percy Islands	54 57	131 33	N	MH	2,025	20	8.37	3,979	A	do	do	
62	do	do	54 58	131 34	N	H	100	20	.41	252	B	do	do	
63	do	do	54 56	131 36	N	T	200	50	2.07	420	B	do	do	
64	do	do	54 55	131 35	N	MH	2,900	161	96.47	21,000	B	do	do	
65	do	do	54 57	131 34	N	H	115	80	1.90	1,160	B	do	do	
66	do	do	54 56	131 33	N	M	880	20	3.64	1,232	B	do	do	
67	do	do	54 56	131 32	N	T	300	175	10.85	2,105	B	do	do	
68	do	do	54 55	131 33	N	H	150	100	3.10	1,900	A	do	do	
69	do	Sealed Passage	54 56	131 29	N	H	1,760	50	18.18	11,099	A	do	do	
70	do	do	54 55	131 30	N	H	2,200	300	136.36	83,160	A	do	do	
71	do	Hall Cove	54 53	131 26	{0.7 N, .3 Mac}	VT	12,300	1,430	3,634.09	243,544	A	do	Nereo Bay	
72	do	Bee Rocks	54 54	131 32	N	M	200	100	4.13	1,400	A	do	Tamgas Harbor	
73	do	Hassler Reef	54 52	131 39	N	M	250	30	1.55	525	B	do	do	
74	do	Bee Rocks	54 52	131 35	N	H	400	400	33.06	25,200	A	do	do	
75	do	do	54 53	131 34	N	H	4,850	950	951.96	580,754	A	do	do	
76	do	Point White	54 53	131 29	N	H	300	20	1.24	756	A	do	do	
77	do	Hall Cove	54 52	131 27	N	H	1,200	500	123.97	75,600	A	do	Nereo Bay	
78	do	Cape Northumberland	54 51	131 26	N	M	400	300	24.79	8,400	A	Ray Anchorage	do	
79	do	West Rock	54 49	131 29	N	M	250	30	1.55	528	B	do	do	
80	do	Barren Island	54 44	131 21	N	M	100	25	.52	175	C	do	do	
81	do	Yellow Rocks	54 46	131 14	N	M	155	30	.96	325	C	do	do	

82	...do...	Club Rocks	54	49	131	21	N	M	500	20	2.07	700	B	....do	....do	
83	...do...	Cape Northumberland	54	50	131	20	N	M	800	30	4.96	1,680	A	....do	....do	
84	...do...	White Rock	54	50	131	23	N	M	400	42	3.47	1,176	A	....do	....do	
85	...do...	Cape Northumberland	54	51	131	22	N	T	2,000	450	185.95	37,800	A	....do	....do	
86	...do...	Kelp Island	54	51	131	19	N	VT	6,300	300	390.50	26,460	A	....do	....do	
87	...do...	Sister Islands	54	51	131	17	N	T	600	20	2.48	280	B	....do	....do	
88	...do...	Kelp Island	54	52	131	15	N	M	1,350	15	4.18	1,417	B	....do	....do	
89	...do...	East Island	54	52	131	12	N	T	1,630	6	2.02	411	B	....do	....do	
90	...do...	Nereo Bay	54	53	131	15	N	M	2,200	75	34.09	11,550	B	....do	....do	
91	...do...	....do	54	52	131	14	N	T	200	100	4.13	840	B	....do	....do	
92	...do...	East Island	54	51	131	12	N	T	880	250	45.45	9,240	A	....do	....do	
93	...do...	Duke Point	54	54	131	12	N	M	200	25	1.03	350	B	....do	....do	
94	...do...	....do	54	55	131	12	N	VT	2,000	75	30.99	11,478	B	....do	Morse Cove	
95	...do...	Morse Cove	54	56	131	13	N	MH	300	34	2.10	1,005	B	....do	....do	
96	...do...	....do	54	56	131	14	N	M	200	40	1.65	560	B	....do	Sheltered	
97	...do...	....do	54	57	131	14	N	M	3,525	50	36.42	12,047	B	....do	Morse Cove	
98	...do...	Grave Point	54	59	131	14	N	M	4,000	36	29.75	10,050	B	....do	Ponds Bay	
99	...do...	....do	55	00	131	15	N	M	500	150	15.50	5,250	B	....do	....do	
100	...do...	Whale Rock	55	01	131	11	N	M	1,300	16	4.30	1,435	C	....do	....do	
101	...do...	Cat Island	55	01	131	15	N	M	2,200	30	13.64	4,620	C	....do	....do	
102	...do...	....do	55	01	131	14	N	MH	350	20	1.45	713	C	....do	....do	
103	...do...	Fripo Island	55	02	131	14	N	M	500	20	2.07	700	C	Customhouse Cove.	....do	
104	...do...	Lane Island	55	02	131	13	N	M	900	20	3.72	1,260	C	....do	....do	
105	...do...	....do	55	01	131	13	N	M	800	30	4.96	1,680	C	....do	....do	
106	...do...	Mary Island	55	02	131	11	N	M	75	40	.62	210	A	....do	....do	
107	...do...	....do	55	03	131	11	N	M	3,500	10	7.23	2,450	C	....do	....do	
108	...do...	....do	55	04	131	11	N	M	900	3	.56	189	B	....do	Point Winslow	
109	...do...	....do	55	05	131	10	N	M	1,320	1	.27	92	C	....do	....do	
110	...do...	Mary Island Light	55	06	131	11	N	MH	2,200	15	6.82	3,245	B	....do	....do	
111	...do...	Twin Islands	55	08	131	13	N	M	600	10	1.24	364	B	....do	....do	
112	...do...	Fish Island	55	00	131	19	N	M	400	13	1.07	334	A	....do	Ponds Bay	
113	...do...	Dog Island	55	00	131	20	N	H	200	25	1.03	575	B	....do	....do	
114	...do...	Duke Island	54	59	131	23	N	MH	3,500	6	4.34	2,299	B	Tamgas Harbor	....do	
115	...do...	....do	54	58	131	26	N	M	2,025	5	2.09	708	C	....do	Tamgas Harbor	
116	...do...	Vegas Islands	54	58	131	28	N	M	2,200	5	2.27	770	B	....do	....do	
117	...do...	Lucky Cove	55	12	131	15	N	M	700	10	1.45	490	B	Thorne Arm	Lucky Cove	C
118	...do...	Point Alava	55	10	131	12	N	T	1,500	4	1.24	252	B	Alava Bay	Alava Bay	
119	...do...	Alava Bay	55	11	131	08	N	M	3,550	4	2.93	994	B	....do	....do	
120	...do...	Ape Point	55	13	131	06	N	T	900	6	1.12	227	B	....do	....do	
121	...do...	Rudyerd Island	55	18	131	02	N	T	1,800	5	1.86	518	B	....do	Sheltered	
122	...do...	Point Sykes	55	12	131	04	N	M	5,100	5	5.27	1,785	B	....do	Point Sykes	
123	...do...	Black Islet	55	09	131	05	N	T	200	40	1.65	336	B	....do	....do	
124	...do...	....do	55	08	131	05	N	T	400	50	4.13	840	C	....do	....do	
125	...do...	Slate Island	55	06	131	04	N	M	800	25	4.13	1,260	C	Boca de Quadra	Kah Shakes Cove	C
126	...do...	....do	55	05	131	01	N	M	300	40	2.48	840	C	....do	....do	C
127	...do...	White Reef	55	04	131	02	N	T	1,760	160	58.18	14,364	B	....do	....do	C
128	...do...	Kah Shakes Point	55	03	131	00	N	T	1,100	100	22.73	4,620	A	....do	....do	C
129	...do...	....do	55	02	131	00	N	M	200	15	.62	210	B	....do	....do	C
130	...do...	Black Rock	55	01	131	03	N	M	1,350	100	27.89	10,190	A	Ray Anchorage	....do	
131	...do...	Kirk Point	55	00	131	00	N	VT	500	393	40.60	1,466	B	....do	Foggy Bay	
132	...do...	Foggy Bay	54	59	131	00	N	T	1,200	4	.99	185	C	....do	....do	

TABLE XXXII.—*Location, area, and tonnage of the surveyed kelp beds of southeast Alaska*—Continued.

Bed No.	Sheet.	Vicinity.	Latitude.	Longitude.	Kind.	Density.	Length.	Width.	Area.	Estimated tonnage.	Availability.	Nearest deep harbor.	Nearest shelter.	Fish industry at harbor.
			° ′	° ′			*Yards.*	*Yards.*	*Acres.*	*Tons.*				
133	G	De Long Islands	54 57	131 00	N	VT	5,600	200	231.40	12,000	B	Ray Anchorage	Foggy Bay	
134	do	Tatoosh Islands	55 31	131 50	N	M	750	12	1.86	294	B	Loring	Moser Bay	C
135	do	Caamano Point	55 30	131 58	N	T	2,000	6	2.48	507	B	Ward Cove	Vallenar Point	C
136	do	Ship Island	55 36	132 12	N	M	1,100	8	1.82	616	B	Hadley	Hadley	
137	do	Meyers Island	55 44	132 16	N	T	1,000	10	2.07	420	C	Misery Island	Meyers Island	C
138	do	Gull Point	55 55	132 25	N	M	250	20	1.03	350	B	McHenry Anchorage.	Dewey Anchorage.	
139	do	Mabel Island	55 56	132 25	N	MH	150	20	.62	295	A	do	do	
140	do	Split Island	55 57	132 27	N	M	940	30	5.83	663	C	do	McHenry Anchorage.	
141	do	Sand Island	55 48	132 27	N	T	1,000	10	2.07	420	A	do	do	
142	do	Quartz Rock	55 59	132 28	N	T	1,100	25	5.68	1,155	B	do	do	
143	do	McHenry Inlet	56 00	132 28	N	T	1,000	50	10.33	2,100	B	McHenry Inlet	McHenry Inlet	
144	do	Burnett Inlet	56 02	132 29	N	M	180	6	.22	176	B	Burnett Inlet	Burnett Inlet	C
145	do	Ratz Point	55 57	132 40	N	M	150	20	.62	210	B	Ratz Harbor	Ratz Harbor	
146	do	Ratz Harbor	55 54	132 36	N	T	300	15	.93	189	B	do	do	
147	do	do	55 53	132 35	N	M	250	10	.52	175	B	do	do	
148	do	Narrow Point	55 50	132 32	N	T	1,500	5	1.55	344	B	do	do	
149	do	do	55 46	132 29	N	T	4,800	3	2.98	622	B	Snug Anchorage.	Snug Anchorage	
150	do	Snug Anchorage	55 44	132 27	N	M	1,560	15	4.84	1,638	B	do	do	
151	do	do	55 43	132 26	N	M	3,850	7	5.57	1,626	B	do	do	
152	do	Tolstoi Island	55 42	132 25	N	T	1,110	7	1.68	326	B	do	do	
153	do	Tolstoi Point	55 40	132 24	N	VT	1,300	6	1.61	133	B	Tolstoi Bay	Tolstoi Bay	
154	do	Windfall Harbor	55 38	132 21	N	M	300	10	.62	210	B	do	Windfall Harbor	
155	do	do	55 36	132 20	N	VT	1,400	8	2.31	164	B	Hadley	do	
156	do	Lyman Point	55 33	132 14	N	T	1,550	3	.96	195	B	do	Hadley	
157	do	Streets Island	55 28	132 08	N	M	200	50	2.07	700	B	do	do	
158	do	Grindall Point	55 28	132 09	N	T	1,900	3	1.18	262	B	do	do	
159	do	Approach Point	55 26	132 07	N	T	425	10	.88	185	B	Saltery Cove	Saltery Cove	C
160	do	Grindall Passage	55 27	132 09	N	M	1,600	5	1.65	550	B	do	do	C
161	do	do	55 27	132 10	N	T	500	15	1.55	315	A	do	do	C
162	do	Clover Bay	55 21	132 09	N	T	860	5	.89	210	B	Clover Bay	Clover Bay	
163	do	do	55 19	132 08	N	M	700	3	.43	147	B	do	do	
164	do	do	55 18	132 08	N	M	1,600	2	.66	258	B	do	do	
165	do	Skin Island	55 18	132 05	N	T	1,760	14	5.09	1,161	A	do	do	
166	do	Cholmondeley Sound	55 16	132 06	N	MH	190	10	.39	210	B	Lancaster Cove	Chasina Anchorage	
167	do	do	55 15	132 08	N	M	1,192	3	.74	238	B	do	Lancaster Cove	
168	do	Babe Islands	55 13	132 09	N	VT	600	200	24.79	1,583	B	do	Sheltered	
169	do	Chasina Anchorage	55 19	132 03	N	M	250	50	2.58	875	B	do	Chasina Anchorage	
170	do	Chasina Point	55 16	132 00	N	T	5,000	10	10.33	2,132	B	do	do	

171	...do...	.....do	55	13	131	59	N	T	7,200	25	37.19	8,492	B	Dolomi	Dolomi	....
172	...do...	Wedge Islands	55	10	131	58	N	M	600	50	6.19	2,100	A	.....do	.....do	....
173	...do...	.....do	55	09	131	58	N	M	85	50	.87	297	A	.....do	.....do	....
174	...do...	.....do	55	08	131	58	N	VT	2,360	300	146.28	2,478	A	.....do	.....do	....
175	...do...	Adams Point	55	07	132	00	N	VT	100	75	1.53	105	C	.....do	.....do	....
176	...do...	Moira Rock	55	05	132	00	N	T	200	60	2.47	494	B	Menefee Anchorage.	Mene fce Anchorage	....
177	...do...	White Rock	55	04	132	00	N	T	1,240	10	2.56	566	B	.....do	.....do	....
178	...do...	.....do	55	03	131	59	N	T	2,500	20	10.33	1,252	B	.....do	.....do	....
179	...do...	Menefee Anchorage	55	02	132	00	N	T	400	10	.83	168	B	.....do	.....do	....
180	...do...	Chichagof Bay	55	02	131	58	N	T	450	10	.92	189	B	.....do	.....do	....
181	...do...	Polk Island	55	00	131	58	N	T	1,500	4	1.24	252	B	Ingraham Bay	Ingraham Bay	....
182	...do...	Ingraham Point	55	00	132	00	N	T	500	20	2.07	420	C	.....do	.....do	....
183	...do...	Ingraham Bay	54	59	131	59	N	T	1,050	5	1.08	178	C	.....do	.....do	....
184	...do...	Scott Point	54	58	131	58	N	T	4,700	5	4.86	762	B	.....do	.....do	....
185	...do...	.....do	54	57	131	58	N	VT	1,110	550	126.14	1,709	C	.....do	.....do	....
186	...do...	Kendrick Bay	54	54	131	59	N	T	875	18	3.25	662	B	Kendrick Bay	Kendrick Bay	....
187	...do...	Kendrick Islands	54	53	131	59	N	VT	2,500	107	55.27	4,445	A	.....do	.....do	....
188	...do...	McLean Point	54	47	131	57	N	T	1,250	2	.52	119	B	Gardner Bay	McLean Arm	....
189	...do...	.....do	54	46	131	59	N	M	1,415	35	10.23	3,003	A	.....do	.....do	....
190	...do...	Cape Chacon	54	43	132	00	N	T	10,000	10	20.66	3,913	A	.....do	.....do	....
191	...do...	Stone Rock	54	44	131	58	N	M	600	7	.87	294	A	.....do	.....do	....
192	...do...	Cape Chacon	54	43	132	00	N	M	150	100	3.10	1,050	A	.....do	.....do	....
193	...do...	.....do	54	42	132	03	N	T	4,650	10	9.64	1,953	B	Nichols Bay	Nichols Bay	....
194	...do...	Nichols Bay	54	42	132	06	N	VT	1,780	450	163.76	11,214	A	.....do	.....do	....
195	...do...	.....do	54	41	132	08	N	T	300	15	.93	189	B	.....do	.....do	....
196	...do...	.....do	54	41	132	10	N	VT	2,500	6	3.10	208	C	.....do	.....do	....
197	...do...	Brownson Bay	54	42	132	12	N	T	2,000	14	5.79	1,175	B	Brownson Bay	Brownson Bay	....
198	...do...	.....do	54	43	132	13	N	T	150	50	1.55	315	B	.....do	.....do	....
199	...do...	.....do	54	43	132	14	N	T	3,900	12	9.67	1,963	C	.....do	.....do	....
200	...do...	.....do	54	44	132	15	N	T	1,140	5	1.18	239	B	.....do	.....do	....
201	...do...	Point Marsh	54	43	132	16	N	T	3,445	20	14.24	2,939	C	.....do	.....do	....
202	...do...	.....do	54	43	132	19	N	T	2,400	10	4.96	896	C	.....do	Hessa Inlet	....
203	...do...	Hessa Inlet	54	44	132	19	N	T	1,500	10	3.10	630	B	Tah Bay	.....do	....
204	...do...	.....do	54	44	132	20	N	T	2,540	5	2.62	609	B	.....do	.....do	....
205	...do...	Mexico Point	54	45	132	23	N	T	3,750	20	15.50	3,220	B	.....do	.....do	....
206	...do...	Hessa Inlet	54	46	132	22	N	T	2,000	13	5.37	1,141	B	.....do	.....do	....
207	...do...	Eureka Pass	54	46	132	23	N	VT	800	15	2.48	168	B	.....do	.....do	....
208	...do...	Hessa Inlet	54	46	132	21	N	T	900	4	.74	154	B	.....do	.....do	....
209	...do...	.....do	54	47	132	20	N	T	1,200	3	.74	154	B	.....do	.....do	....
210	...do...	.....do	54	48	123	20	N	VT	2,600	4	2.15	284	B	.....do	.....do	....
211	...do...	.....do	54	47	132	22	N	T	1,850	5	1.91	346	B	.....do	.....do	....
212	...do...	Eureka Pass	54	47	132	23	N	VT	1,400	20	5.79	700	B	.....do	.....do	....
213	...do...	.....do	54	46	132	25	N	T	4,895	30	30.34	7,955	B	.....do	Leading Point	....
214	...do...	Barrier Islands	54	48	132	25	0.1 Mac .9 N	MH	4,12 0	20	17.02	9,080	A	.....do	Sheltered	....
215	...do...	.....do	54	46	132	26	N	VT	800	500	82.64	5,600	B	.....do	Leading Point	....
216	...do...	.....do	54	47	132	27	0.2 Mac .8 N	VT	3,100	121	77.50	4,576	B	.....do	.....do	....
217	...do...	.....do	54	46	132	28	N	M	200	150	6.20	2,100	A	.....do	.....do	....
218	...do...	.....do	54	46	132	28	N	T	600	20	2.49	494	A	.....do	.....do	....
219	...do...	.....do	54	47	132	28	N	M	3,500	10	7.23	2,450	B	.....do	.....do	....

TABLE XXXII.—*Location, area, and tonnage of the surveyed kelp beds of southeast Alaska*—Continued.

Bed No.	Sheet.	Vicinity.	Latitude.	Longitude.	Kind.	Density.	Length.	Width.	Area.	Estimated tonnage.	Availability.	Nearest deep harbor.	Nearest shelter.	Fish industry at harbor.
			° ′	° ′			*Yards.*	*Yards.*	*Acres.*	*Tons.*				
220	G	Dewey Rocks	54 45	132 30	N	M	400	20	1.65	560	C	Tah Bay	Leading Point	
221	do	Barrier Islands	54 46	132 30	N	M	400	100	8.26	2,800	A	do	do	
222	do	Round Islands	54 46	132 31	N	H	4,000	10	8.26	5,005	B	do	do	
223	do	do	54 46	132 32	N	M	2,000	50	20.66	7,000	B	do	do	
224	do	Egg Rock	54 47	132 31	N	MH	200	25	1.03	491	B	do	do	
225	do	Barrier Islands	54 47	132 30	N	M	1,500	75	23.22	7,875	B	do	do	
226	do	do	54 48	132 31	N	M	100	20	.41	140	B	do	do	
227	do	Boat Rocks	54 49	132 31	N	M	650	35	4.69	2,222	A	do	do	
228	do	Barrier Islands	54 49	132 30	0.5 Mac .5 N	MH	400	5	4.13	126	B	do	do	
229	do	do	54 49	132 29	N	M	200	30	1.25	420	A	do	do	
230	do	do	54 48	132 29	0.6 Mac .4 N	H	7,779	152	244.30	73,560	A	do	do	
231	do	do	54 49	132 27	0.5 Mac .5 N	VT	400	15	1.24	54	C	do	do	
232	do	do	54 49	132 26	M	H	7,050	234	341.16	49,791	A	do	do	
233	do	Eureka Pass	54 49	132 24	N	M	3,140	60	38.93	4,618	A	do	do	
234	do	Barrier Islands	54 51	132 27	N	M	100	25	.51	175	A	do	Hunter Bay	
235	do	Tah Bay	54 49	132 21	0.9 Mac .1 N	M	450	15	13.95	1,605	B	do	Leading Point	
236	do	Turn Island	54 52	132 24	N	T	150	50	1.55	315	B	Hunter Bay	Hunter Bay	C
237	do	Klakas Inlet	54 53	132 26	N	M	375	22	1.65	577	B	do	do	C
238	do	do	54 54	132 27	N	M	400	10	.83	280	C	do	Ruth Bay	C
239	do	Ship Islands	54 54	132 32	N	T	350	30	2.16	431	B	Kassa Inlet	Kassa Inlet	
240	do	do	54 54	132 33	N	M	2,125	30	13.17	4,462	A	do	do	
241	do	Kassa Inlet	54 55	132 35	N	M	450	50	4.62	1,575	B	do	do	
242	do	do	54 56	132 32	0.7 Mac .3 N	MH	800	100	16.53	3,470	B	do	do	
243	do	Point Webster	54 57	132 35	N	VT	800	50	8.26	140	C	do	do	
244	do	do	54 57	132 36	N	M	450	60	5.58	1,575	B	do	do	
245	do	do	54 58	132 36	N	M	150	75	2.32	787	B	Hassiah Inlet	Hassiah Inlet	
246	do	do	54 58	132 37	N	M	300	50	3.10	1,050	B	do	do	
247	do	do	54 59	132 37	N	VT	1,000	200	41.32	3,010	A	do	do	
248	do	Hassiah Inlet	54 59	132 36	N	M	100	25	.51	175	B	do	do	
249	do	Mabel Island	55 00	132 36	Mac	M	2,000	3	1.24	120	B	do	do	
250	do	Hassiah Inlet	55 00	132 34	Mac	M	100	100	2.07	200	A	do	Sheltered	
251	do	Lime Point	55 04	132 38	Mac	M	5,550	2	2.27	222	B	Hetta	do	
252	do	Eek Point	55 08	132 41	Mac	VT	2,640	7	3.82	306	B	do	Eek Inlet	
253	do	Sukkwan Strait	55 09	132 45	Mac	M	4,400	2	1.82	190	B	Hydeburg	Sheltered	
254	do	do	55 10	132 47	Mac	MH	100	100	2.07	250	A	do	do	
255	do	do	55 10	132 48	Mac	T	600	100	12.39	741	B	do	do	

256	F	Hydeburg	55	11	132	50	Mac	T	200	25	1.03	62	A	do	do	
257	do	do	55	11	132	49	0.6 Mac, 4.4 N	MH	2,125	10	4.39	1,310	B	do	do	
258	do	do	55	12	132	51	Mac	MH	2,000	61	24.79	1,550	A	do	do	
259	do	Confusion Bay	55	13	132	52	Mac	H	200	50	2.06	300	B	do	do	
260	do	do	55	12	132	53	Mac	MH	510	100	10.54	1,442	B	do	do	
261	do	do	55	11	132	53	Mac	H	100	25	.51	75	B	do	do	
262	do	do	55	10	132	53	Mac	M	1,200	3	.74	78	B	do	Confusion Bay	
263	do	Corlies Islands	55	09	132	54	Mac	T	2,000	15	6.20	307	A	do	do	
264	do	Pantaloon Island	55	09	132	54	Mac	M	50	50	.51	30	B	do	do	
265	do	Turn Rock	55	09	132	56	Mac	M	700	20	2.89	300	B	do	do	
266	do	Pantaloon Island	55	09	132	57	Mac	M	600	75	9.30	900	B	do	do	
267	do	do	55	10	132	57	Mac	T	300	50	3.10	189	B	do	do	
268	do	do	55	11	132	57	Mac	T	500	50	5.17	212	B	do	do	
269	do	Halibut Nose	55	13	133	03	0.7 Mac, .3 N	M	175	30	1.08	185	B	North Bay	Soda Bay	
270	do	do	55	14	133	03	Mac	T	1,700	15	5.27	341	B	do	do	
271	do	Tlevak Narrows	55	16	133	05	Mac	T	350	20	1.44	87	C	do	Sheltered	
272	do	do	55	15	133	05	Mac	VT	200	100	4.13	100	A	do	do	
273	do	do	55	16	133	07	N	M	1,500	9	2.78	1,085	B	Tlevak Bay	do	
274	do	do	55	15	133	08	N	MH	600	20	2.48	1,104	A	do	do	
275	do	do	55	15	133	06	N	MH	350	100	7.23	3,720	A	North Bay	Tlevak Narrows	
276	do	Lively Islands	55	15	133	05	N	T	1,200	5	1.24	252	B	do	North Bay	
277	do	do	55	14	133	05	N	T	400	20	1.65	336	B	do	do	
278	do	Guide Island	55	14	133	04	N	M	100	50	1.03	350	B	do	do	
279	do	Corlies Islands	55	08	132	54	Mac	T	500	250	25.83	1,562	B	Dunbar Inlet	Confusion Bay	
280	do	do	55	08	132	54	Mac	T	1,115	650	149.74	9,054	B	do	do	
281	do	do	55	07	132	54	Mac	M	200	20	0.83	80	A	do	Dunbar Inlet	
282	do	Dunbar Inlet	55	06	132	52	Mac	T	3,550	60	44.00	2,662	B	do	do	
283	do	McFarland Islands	55	04	132	54	Mac	T	15,560	15	48.22	2,917	B	do	do	
284	do	do	55	04	132	56	Mac	T	1,400	10	2.89	150	B	do	do	
285	do	Dunbar Inlet	55	04	132	53	Mac	T	800	60	9.92	600	B	do	do	
286	do	do	55	03	132	54	Mac	T	4,450	100	91.94	5,562	B	do	do	
287	do	Bushy Island	54	57	132	56	Mac	M	1,750	50	18.08	1,550	B	Rose Inlet	Rose Inlet	C
288	do	Grace Harbor	54	55	132	53	Mac	M	200	50	2.07	200	C	do	Grace Harbor	C
289	do	Sawmill Cove	54	53	132	52	Mac	T	6,000	140	173.55	5,250	B	Howkan	Sawmill Cove	S
290	do	Howkan Narrows	54	51	132	50	N	M	2,900	10	5.99	2,159	A	do	Hokwan	S
291	do	Kaigani Strait	54	50	132	47	N	M	2,450	5	2.53	857	D	do	do	S
292	do	Howkan	54	51	132	49	N	VH	1,000	50	10.33	7,070	B	do	do	S
293	do	do	54	52	132	49	0.7 Mac, .3 N	T	2,240	4	1.85	176	C	do	do	S
294	do	Channel Islands	54	52	132	50	N	M	1,000	17	3.51	1,190	A	do	do	S
295	do	Shoe Island	54	55	132	50	Mac	M	3,500	50	36.16	3,500	B	do	Quiet Cove	S
296	do	Quiet Cove	54	56	132	48	Mac	T	3,100	10	6.41	394	B	do	do	S
297	do	do	54	57	132	47	Mac	T	500	10	1.03	62	B	do	do	S
298	do	Aston Island	54	57	132	51	Mac	VT	2,120	1,550	678.93	16,430	A	Rose Inlet	do	C
299	do	Square Island	54	58	132	53	Mac	T	3,000	1,000	619.83	37,500	B	do	Rose Inlet	C
300	do	Grand Island	54	59	132	52	Mac	M	600	15	1.86	180	B	do	do	C
301	do	do	54	59	132	51	Mac	M	225	50	2.53	225	C	do	do	C
302	do	do	54	57	132	49	Mac	M	100	25	0.51	50	B	do	Quiet Cove	C
303	do	Dumbell Bay	54	55	132	45	Mac	M	700	310	44.83	4,340	B	Duck Bay	Dumbell Bay	
304	do	do	54	56	132	45	N	M	1,500	20	6.20	2,100	B	do	do	

TABLE XXXII.—*Location, area, and tonnage of the surveyed kelp beds of southeast Alaska*—Continued.

Bed No.	Sheet.	Vicinity.	Latitude.		Longitude.		Kind.	Density.	Length.	Width.	Area.	Estimated tonnage.	Availability.	Nearest deep harbor.	Nearest shelter.	Fish industry at harbor.
			°	′	°	′			*Yards.*	*Yards.*	*Acres.*	*Tons.*				
305	F	Dumbell Bay	54	57	132	43	N	H	100	100	2.07	1,260	A	Duck Bay	Dumbell Bay	
306	do	do	54	46	132	42	Mac	T	250	20	1.03	62	B	do	do	
307	do	do	54	55	132	42	Mac	T	450	15	1.39	84	C	do	Duck Bay	
308	do	Duck Bay	54	55	132	41	Mac	M	500	75	7.75	750	B	do	do	
309	do	do	54	55	132	40	Mac	T	400	200	16.53	200	B	do	do	
310	do	do	54	54	132	39	Mac	M	800	10	1.65	160	B	do	do	
311	do	do	54	53	132	37	Mac	H	500	9	.93	121	C	do	do	
312	do	do	54	52	132	37	N	MH	550	34	3.86	1,867	B	do	do	
313	do	Coning Inlet	54	51	132	37	N	M	100	25	0.52	175	A	do	do	
314	do	do	54	48	132	37	N	VT	700	20	2.89	196	B	do	do	
315	do	do	54	47	132	36	N	T	4,475	6	5.55	1,550	B	do	do	
316	do	Kaigani Harbor	54	45	132	43	N	M	150	20	.62	210	B	Howkan	Kaigani Harbor	S
317	do	Datzkoo Islands	54	43	132	42	N	M	900	900	167.36	56,700	C	do	do	S
318	do	do	54	43	132	41	N	H	400	20	1.65	1,008	C	do	McLeod Bay	S
319	do	McLeod Bay	54	42	132	42	N	M	1,550	10	3.20	1,085	C	do	do	S
320	do	Cape Muzon	54	40	132	40	N	M	300	25	1.54	525	D	do	do	S
321	do	do	54	40	132	41	N	H	200	10	.42	252	B	do	do	S
322	do	Port Bazan	54	47	132	58	N	M	1,700	50	17.56	5,950	C	Port Bazan	Port Bazan	
323	do	do	54	48	132	59	N	M	1,600	35	11.78	3,920	B	do	do	
324	do	do	54	48	133	00	N	T	1,500	5	1.55	315	B	do	do	
325	do	Cape Magdalena	54	49	133	01	N	M	1,500	5	1.55	525	B	do	do	
326	do	Gooseneck Harbor	54	51	133	04	N	M	1,800	8	2.97	1,008	C	do	Gooseneck Harbor	
327	do	do	54	52	133	05	N	M	1,800	20	7.44	2,520	B	do	do	
328	do	do	54	53	133	06	N	M	300	15	.93	315	C	do	do	
329	do	do	54	53	133	08	N	VT	100	25	.52	35	D	Waterfall Bay	do	S
330	do	Gold Harbor	54	55	133	11	N	M	1,500	15	4.65	1,575	C	do	Gold Harbor	S
331	do	do	54	56	133	17	N	M	3,000	25	15.50	5,250	B	do	do	S
332	do	Waterfall Bay	54	57	133	12	N	T	400	5	.41	84	C	do	Waterfall Bay	S
333	do	do	54	57	133	12	N	T	3,000	3	1.86	378	C	do	do	S
334	do	do	54	56	133	13	N	M	300	15	.93	315	D	do	do	S
335	do	Forrester Island	54	47	133	31	N	T	12,310	12	30.52	7,043	B	do	Fishing Camp	S
336	do	do	54	50	133	32	{0.4 N, .6 Al}	M	100	40	.83	117	B	do	do	S
337	do	do	54	50	133	33	{0.8 N, .2 Al}	M	300	30	1.86	508	B	do	do	S
338	do	Lowrie Island	54	51	133	31	N	M	2,200	230	104.55	21,252	C	do	do	S
339	do	do	54	52	133	32	N	MH	200	100	4.13	1,970	B	do	do	S
340	do	Wolf Rock	55	00	133	30	N	M	1,000	8	1.65	560	C	do	Reef Bay	S
341	do	Augustine Bay	54	58	133	12	N	M	500	10	1.03	350	D	do	Augustine Bay	S
342	do	Sakie Bay	55	00	133	11	{0.1 Al, .9 N}	M	11,750	40	97.11	29,083	C	do	do	S

343	...do...	Cape Waynick	55	02	133	15	N	M	10,450	35	75.57	25,601	C	Port Clark	Reef Bay	
344	...do...	Reef Bay	55	04	133	15	N	M	400	100	8.26	2,800	D	do	do	
345	...do...	Cape Lookout	55	06	133	18	N	MH	2,000	100	41.12	19,700	B	do	Port Clark	
346	...do...	do	55	06	133	15	{0.9 N, .1 Al}	MH	2,200	30	13.64	4,306	C	do	do	
347	...do...	Port Clark	55	06	133	10	Mac	H	100	50	1.03	150	B	do	do	
348	...do...	Juel Point	55	07	133	14	{0.8 N, .2 Mac}	T	8,650	15	26.80	4,684	B	do	do	
349	...do...	Divers Rock	55	09	133	16	N	T	7,775	50	80.32	16,427	B	Bobs Bay	Bobs Bay	
350	...do...	Cameron Harbor	55	09	133	12	Mac	M	500	10	1.03	100	B	do	Sheltered	
351	...do...	Bobs Bay	55	10	133	13	{0.9 Mac, .1 N}	VT	4,400	10	9.09	1,200	B	do	do	
352	...do...	do	55	11	133	10	Mac	MH	1,500	450	139.46	20,250	A	do	do	
353	...do...	do	55	12	133	10	Mac	M	100	25	0.51	50	A	do	do	
354	...do...	do	55	11	133	14	{0.8 N, .2 Mac}	VT	550	250	28.40	839	B	do	Bobs Bay	
355	...do...	Eagle Point	55	13	133	13	N	T	4,800	2	1.98	358	C	Tlevak Bay	do	
356	...do...	Tlevak Narrows	55	15	133	11	N	M	1,780	4	1.47	463	B	do	Tlevak Bay	
357	...do...	Tlevak Bay	55	15	133	09	N	MH	550	14	1.59	693	B	do	do	
358	...do...	Tlevak Narrows	55	15	133	09	N	M	250	75	3.87	1,207	B	do	do	
359	...do...	do	55	16	133	10	N	M	100	50	1.03	350	B	do	do	
360	...do...	Waterfall	55	16	133	12	N	M	600	5	0.62	210	C	Waterfall	Waterfall	C
361	...do...	do	55	16	133	13	N	M	300	10	0.62	210	C	do	do	C
362	...do...	Meares Passage	55	15	133	13	N	M	185	63	2.40	816	A	Tlevak Bay	Tlevak Bay	
363	...do...	do	55	14	133	15	N	M	620	5	6.41	2,170	B	do	Bobs Bay	
364	...do...	Millars Reef	55	12	133	17	N	T	2,700	50	27.89	5,670	C	Bobs Bay	do	
365	...do...	Port Basalt	55	12	133	22	N	T	2,300	200	95.04	19,320	C	do	do	
366	...do...	do	55	13	133	23	N	M	400	50	4.13	1,400	C	do	do	
367	...do...	Point Rosary	55	14	133	29	N	M	2,000	24	9.92	3,360	C	Port Santa Cruz	Port Santa Cruz	
368	...do...	Port Santa Cruz	55	15	133	27	{0.5 N, .5 Mac}	H	6,650	25	34.33	13,023	B	do	do	
369	...do...	do	55	16	133	24	N	H	450	50	4.65	675	A	do	do	
370	...do...	do	55	16	133	26	N	M	200	10	0.41	140	B	do	do	
371	...do...	Point San Jose	55	17	133	28	N	M	700	5	0.72	263	C	do	do	
372	...do...	Point Arboleda	55	18	133	29	N	T	700	10	1.45	294	C	do	do... es	
373	...do...	do	55	19	133	29	N	T	200	100	4.13	840	D	Port Dolores	Port Dolores	
374	...do...	do	55	19	133	28	{0.9 N, .1 Mac}	T	1,330	15	4.12	779	B	do	do	
375	...do...	Point Remedios	55	20	133	26	Mac	H	200	10	0.41	60	B	do	do	
376	...do...	Point Arucenas	55	20	133	24	N	T	1,500	2	4.62	126	C	do	do	
377	...do...	Cabras Islands	55	21	133	24	N	M	700	20	2.89	980	A	do	do	
378	...do...	Point Cangrejo	55	21	133	21	{0.4 N, .6 Mac}	M	225	20	0.93	215	B	do	do	
379	...do...	Adrian Cove	55	20	133	19	Mac	H	2,200	10	4.54	660	B	Port Estrella	Adrian Cove	
380	...do...	Point Verde	55	18	133	18	Mac	M	3,100	25	16.00	1,550	C	Waterfall	Port Refugio	C
381	...do...	Waterfall	55	17	133	14	Mac	M	2,000	3	1.24	120	C	do	Waterfall	C
382	...do...	Cape Flores	55	20	133	16	Mac	M	4,800	30	29.75	2,880	B	Port Estrella	Port Estrella	
383	...do...	Point Providence	55	22	133	16	Mac	M	6,200	15	19.22	1,860	A	do	do	
384	...do...	Tranquil Point	55	23	133	13	Mac	M	400	8	0.66	220	B	Port Caldera	Port Caldera	
385	...do...	Point Batan	55	23	133	11	Mac	M	300	20	1.24	120	C	do	do	
386	...do...	Craig	55	29	133	09	Mac	T	600	20	2.49	500	B	Craig	Craig	C
387	...do...	Fish Egg Island	55	29	133	11	Mac	VT	2,200	800	363.64	11,273	A	do	do	C

TABLE XXXII.—*Location, area, and tonnage of the surveyed kelp beds of southeast Alaska*—Continued.

Bed No.	Sheet.	Vicinity.	Latitude.	Longitude.	Kind.	Density.	Length.	Width.	Area.	Estimated tonnage.	Availability.	Nearest deep harbor.	Nearest shelter.	Fish industry at harbor.
			° ′	° ′			*Yards.*	*Yards.*	*Acres.*	*Tons.*				
388	F	Ballena Islands	55 29	133 12	Mac	M	900	150	27.89	8,420	B	Craig	Craig	C
389	do	do	55 29	133 11	Mac	M	1,400	65	18.70	1,820	B	do	do	C
390	do	do	55 29	133 12	Mac	M	700	300	43.39	4,200	B	do	do	C
391	do	Balandra Island	55 25	133 13	Mac	M	1,050	45	9.76	945	B	do	do	C
392	do	San Juan Bautista Island	55 25	133 16	Mac	T	8,000	10	16.32	1,000	C	do	do	C
393	do	Agueda Point	55 26	133 16	Mac	MH	500	60	6.20	750	A	do	do	C
394	do	San Juan Bautista Island	55 26	133 17	Mac	T	8,900	15	27.59	1,669	B	do	do	C
395	do	Point Cocos	55 23	133 26	N	M	3,100	3	1.92	651	C	Port Asumcion	Santa Rita Island	
396	do	Santa Rita Island	55 24	133 28	Mac	VT	3,550	200	146.60	3,550	A	do	do	
397	do	Cristina Island	55 23	133 28	N	M	275	80	4.55	1,540	B	do	do	
398	do	Port Asumcion	55 22	133 33	0.3 N, .7 Mac	T	5,500	3	3.41	356	C	do	Port Asumcion	
399	do	do	55 22	133 34	Mac	M	3,100	8	5.12	496	C	do	do	
400	do	Port San Antonio	55 20	133 36	0.2 N, .8 Mac	T	8,900	5	9.19	514	B	Port San Antonio.	Port San Antonio	
401	do	do	55 22	133 38	Mac	VT	600	200	24.80	600	A	do	do	
402	do	do	55 21	133 38	Mac	T	600	15	1.86	112	B	do	do	
403	do	do	55 20	133 37	Mac	T	2,700	25	13.95	844	A	do	do	
404	do	Cape Bartolome	55 18	133 38	0.1 Mac, .9 N	VT	12,700	5	13.12	757	C	do	do	
405	do	Mid Point	55 17	133 40	N	M	400	8	.66	224	D	Raven Bay	Raven Bay	
406	do	do	55 20	133 42	N	M	500	5	.52	175	D	do	do	
407	do	Crevice Point	55 25	133 39	N	VT	2,450	100	50.62	3,430	B	do	do	
408	do	Obstruction Narrows	55 25	133 36	N	MH	5,200	15	16.12	6,724	B	do	do	
409	do	do	55 25	133 34	N	M	800	10	1.65	560	B	Wolf Bay	Wolf Bay	
410	do	do	55 26	133 33	Mac	M	200	50	2.07	700	A	do	do	
411	do	Cone Island	55 26	133 36	N	T	10,620	95	208.45	42,383	B	Raven Bay	Raven Bay	
412	do	Point San Isidor	55 27	133 35	N	MH	10,060	55	114.32	54,500	B	do	St. Nicholas Cove	
413	do	St. Nicholas Canal	55 28	133 37	N	H	300	50	3.10	1,900	A	do	do	
414	do	do	55 28	133 37	N	M	60	60	.75	252	C	do	do	
415	do	do	55 27	133 38	N	T	200	10	.41	84	C	do	do	
416	do	Point Magnetite	55 27	133 38	N	M	3,300	10	6.82	2,342	B	do	Raven Bay	
417	do	Outside Bay	55 28	133 47	N	T	3,400	10	7.02	1,820	C	Outside Bay	Outside Bay	
418	do	do	55 28	133 46	0.3 Mac, .7 N	T	1,600	25	8.47	1,326	D	do	do	
419	do	Open Bay	55 30	133 46	N	M	3,100	30	19.21	6,510	C	do	do	
420	do	do	55 31	133 43	N	M	1,000	10	2.07	700	D	do	Open Bay	
421	do	Spray Point	55 31	133 46	N	M	200	15	.62	210	D	do	do	
422	do	Point Protection	55 33	133 43	N	M	150	50	1.55	525	D	Deepwater Bay	Foster Cove	
423	do	do	55 33	133 43	0.4 Mac, .6 N	MH	1,000	60	12.40	4,156	A	do	do	

424	...do...	San Pedro Island..........	55	35	133	43	N	H	1,100	10	2.27	1,386	....	Lorenzo Harbor	.....do............	S
425	...do...	.....do.....................	55	36	133	43	N	M	2,900	20	11.98	4,060	B	.....do..........	San Lorenzo Harbor.	S
426	...do...	Foster Cove................	55	33	133	40	0.1 Mac .9 N	M	5,550	20	22.93	9,213	B	Deepwater Bay	Foster Cove.......	....
427	...do...	Deepwater Bay............	55	36	133	37	0.2 Mac .8 N	T	2,200	10	4.55	794	C	.....do..........	Deepwater Bay...	....
428	...do...	.....do.....................	55	31	133	34	0.5 Mac .5 N	M	9,000	40	74.38	16,200	A	.....do..........	.....do............	....
429	...do...	St. Nicholas Canal.........	55	30	133	34	N	T	4,000	10	8.26	1,680	B	St. Nicholas Cove.	St. Nicholas Cove.	....
430	...do...	.....do.....................	55	29	133	34	N	MH	250	26	1.34	596	B	.....do..........	.....do............	....
431	...do...	St. Nicholas Cove..........	55	29	133	33	N	T	600	4	.49	101	C	.....do..........	.....do............	....
432	...do...	.....do.....................	55	29	133	33	N	M	800	50	8.26	2,800	B	.....do..........	.....do............	....
433	...do...	San Francisco Island......	55	30	133	32	N	T	1,700	75	26.35	4,641	B	.....do..........	.....do............	....
434	...do...	Point Santa Gertrudis....	55	31	133	32	N	VT	500	300	30.99	2,100	A	.....do..........	.....do............	....
435	...do...	.....do.....................	55	31	133	30	0.5 N .5 Mac	M	7,000	25	36.16	7,875	B	.....do..........	.....do............	....
436	...do...	Portillo Channel..........	55	30	133	24	Mac	T	4,000	10	8.26	5,000	B	.....do..........	Pine Point........	....
437	...do...	.....do.....................	55	29	133	26	0.5 Mac .5 N	VT	800	400	66.12	3,800	B	Wolf Bay.......	.....do............	....
438	...do...	Pine Point...................	55	26	133	28	Mac	MH	1,550	30	9.60	1,162	B	.....do..........	.....do............	....
439	...do...	Port Real Marina..........	55	26	133	23	Mac	T	120	30	.74	45	C	.....do..........	Sheltered..........	....
440	...do...	Pine Point...................	55	26	133	25	Mac	T	800	100	16.53	1,000	B	.....do..........	Pine Point.........	....
441	...do...	St. Ignace Island..........	55	25	133	26	0.9 Mac .1 N	T	3,700	22	16.82	1,258	C	.....do..........	Santa Rita Island.	....
442	...do...	Pine Point...................	55	26	133	26	Mac	H	50	50	.51	75	A	.....do..........	Pine Point.........	....
443	...do...	Portilla Channel..........	55	28	133	24	0.4 Mac .6 N	VT	7,000	700	1,012.40	12,740	A	.....do..........	Sword Point......	....
444	...do...	Point Amargura...........	55	28	133	21	Mac	T	2,700	15	8.40	506	B	Craig............	.....do............	C
445	...do...	Snail Point.................	55	32	133	28	0.4 Mac .6 N	VT	5,600	80	92.56	4,759	B	St. Nicholas Cove.	Garcia Harbor....	....
446	...do...	Point Garcia...............	55	33	133	28	N	MH	250	40	2.07	1,260	B	Deepwater Bay	.....do............	....
447	...do...	.....do.....................	55	33	133	27	0.5 Mac .5 N	M	1,700	10	3.51	765	C	.....do..........	.....do............	....
448	...do...	Hermagos Islands.........	55	34	133	29	N	T	600	20	2.49	494	B	.....do..........	.....do............	....
449	...do...	.....do.....................	55	34	133	29	N	H	100	50	1.03	630	A	.....do..........	.....do............	....
450	...do...	Garcia Harbor.............	55	33	133	26	Mac	M	400	5	.41	40	C	.....do..........	.....do............	....
451	...do...	Hermagos Islands.........	55	34	133	25	N	T	275	10	.57	136	B	.....do..........	.....do............	....
452	...do...	Point San Pasqual........	55	34	133	25	N	M	1,500	2	.62	210	C	.....do..........	.....do............	....
453	...do...	Palisade Point.............	55	34	133	22	Mac	H	300	50	3.10	450	B	.....do..........	.....do............	....
454	...do...	Larzatita Island...........	55	34	133	19	N	T	1,200	10	2.48	504	B	Craig............	Cruz Harbor......	C
455	...do...	Point Santa Lucia.........	55	33	133	20	N	T	1,550	3	.96	195	C	.....do..........	.....do............	C
456	...do...	.....do.....................	55	34	133	20	N	M	120	50	1.24	42	A	.....do..........	.....do............	C
457	...do...	Cruz Island.................	55	33	133	19	N	MH	150	20	.62	290	C	.....do..........	.....do............	C
458	...do...	Hermanos Islets...........	55	34	133	18	N	M	50	50	.51	175	A	.....do..........	Fonso Cove........	C
459	...do...	Piedras Island.............	55	33	133	17	N	T	730	20	3.02	586	C	.....do..........	Cruz Harbor.......	C
460	...do...	San Alberto Bay...........	55	32	133	15	N	M	400	20	1.65	574	A	.....do..........	.....do............	C
461	...do...	Fern Point..................	55	31	133	17	Mac	VT	3,100	20	12.80	310	C	.....do..........	.....do............	C
462	...do...	.....do.....................	55	30	133	18	Mac	T	600	10	1.24	75	C	.....do..........	.....do............	C
463	...do...	Fonso Cove.................	55	34	133	17	N	T	450	20	1.86	392	B	.....do..........	Fonso Cove........	C
464	...do...	Rosary Island..............	55	35	133	18	N	VT	3,000	50	30.99	525	A	.....do..........	.....do............	C

TABLE XXXII.—*Location, area, and tonnage of the surveyed kelp beds of southeast Alaska*—Continued.

Bed No.	Sheet.	Vicinity.	Latitude.	Longitude.	Kind.	Density.	Length.	Width.	Area.	Estimated tonnage.	Availability.	Nearest deep harbor.	Nearest shelter.	Fish industry at harbor.
			° ′	° ′			*Yards.*	*Yards.*	*Acres.*	*Tons.*				
465	F	San Christoval Channel	55 35	133 19	N	MH	2,250	8	3.71	1,773	B	Craig	Fonso Cove	C
466	do	do	55 36	133 20	N	M	400	15	1.24	420	B	do	do	C
467	do	do	55 36	133 20	N	T	1,000	5	1.03	210	C	Lorenzo Harbor	do	S
468	do	Blanquizal Islands	55 36	133 24	N	T	2,200	10	4.55	920	D	do	Philip Anchorage	S
469	do	St. Philip Island	55 38	133 26	N	MH	200	15	.62	295	D	do	do	S
470	do	Anguilla Islands	55 38	133 36	0.9 Mac, .1 N	M	550	120	13.64	1,650	B	do	Lorenzo Harbor	S
471	do	San Lorenzo Islands	55 37	133 36	N	MH	1,550	50	16.01	5,425	B	do	do	S
472	do	do	55 36	133 31	N	M	2,000	4	1.65	560	C	do	do	S
473	do	do	55 36	133 37	N	M	2,000	5	2.07	700	C	do	do	S
474	do	do	55 36	133 38	N	M	4,000	15	12.40	4,200	C	do	do	S
475	do	do	55 37	133 37	0.8 Mac, .2 N	MH	1,675	20	6.92	1,533	C	do	do	S
[1] 476	do	Anguilla Islands	55 38	133 37	.8 Mac, .2 N	T	(?)	(?)	77.96	11,604	C	do	do	S
477	do	San Lorenzo Islands	55 38	133 39	N	MH	80	40	.66	314	C	do	do	S
478	do	Anguilla Islands	55 39	133 41	N	M	3,000	100	61.98	20,950	C	do	do	S
479	do	Wood Island	55 40	133 43	N	T	2,700	600	334.71	158,340	B	do	Anguilla Anchorage.	S
480	do	Anguilla Islands	55 41	133 40	N	T	2,200	500	227.27	46,200	C	do	do	S
481	do	do	55 41	133 41	N	MH	300	100	6.20	2,950	C	do	do	S
482	do	do	55 40	133 36	Mac	T	2,000	5	2.07	125	B	do	do	S
483	do	do	55 42	133 38	N	M	300	30	1.86	630	C	do	do	S
484	do	do	55 41	133 37	N	T	1,760	150	54.55	10,988	B	do	do	S
485	do	do	55 42	133 39	N	M	700	85	12.30	4,161	B	do	do	S
486	do	Bushtop Island	55 41	133 36	0.9 Mac, .1 N	M	1,625	10	3.36	900	B	Swifts Bay	do	C
487	do	Anguilla Anchorage	55 41	133 35	Mac	T	1,500	50	15.50	930	B	do	do	C
488	do	Anguilla Islands	55 40	133 33	N	M	2,000	5	2.07	700	B	do	do	C
489	do	do	55 40	133 34	N	H	50	50	0.51	316	A	do	do	C
490	do	Bocas de Finas	55 42	133 34	N	M	4,300	10	8.88	3,000	B	do	do	C
491	do	Twocrack Island	55 42	133 31	N	M	2,000	20	8.26	2,800	B	do	do	C
492	do	Emerald Island	55 43	133 42	N	H	200	100	4.13	1,520	C	do	do	C
493	do	do	55 42	133 41	N	MH	1,200	200	49.59	22,080	B	do	do	C
494	do	Cape Lynch	55 45	133 42	N	VT	800	100	16.53	1,110	C	Port Alice	Port Alice	
495	do	do	55 46	133 40	0.4 Mac, .6 N	T	12,540	100	259.09	54,278	B	do	do	
496	do	Gull Island	55 45	133 45	N	M	1,100	35	7.95	2,688	D	do	do	
497	do	Surf Point	55 49	133 40	N	VT	10,000	130	268.60	33,560	C	do	do	
498	do	Port Alice	55 49	133 34	0.4 Mac, .6 N	M	7,350	25	37.96	10,000	B	do	do	

499	...do...	Gas Rock	55	51	133	35	N	H	700	20	2.90	1,764	B	....do	....do	....
500	...do...	Sea Otter Sound	55	49	133	31	N	M	4,500	22	20.45	2,200	B	....do	....do	....
501	...do...	Karheen	55	48	133	18	N	T	1,900	6	2.36	479	B	Karheen	Karheen	C
502	...do...	....do	55	47	133	19	N	T	100	75	1.55	315	B	....do	....do	C
503	...do...	....do	55	46	133	20	N	M	300	20	1.24	420	B	....do	....do	C
504	...do...	....do	55	45	133	21	N	VT	500	10	1.03	70	C	....do	....do	C
505	...do...	....do	55	45	133	20	N	T	1,000	33	6.82	1,386	C	....do	....do	C
506	...do...	....do	55	45	133	18	N	VT	300	150	9.30	840	A	....do	....do	C
507	...do...	....do	55	46	133	19	N	VT	300	50	3.10	210	A	....do	....do	C
508	...do...	....do	55	46	133	17	N	VT	1,100	150	34.09	577	A	....do	....do	C
509	...do...	....do	55	49	133	21	N	VT	200	200	8.26	280	A	....do	....do	C
510	...do...	Turn Point	55	50	133	22	N	T	1,000	5	1.03	210	B	....do	....do	C
511	...do...	....do	55	51	133	21	N	M	100	100	2.07	700	A	....do	....do	C
512	...do...	Cap Island	55	53	133	21	N	VT	150	75	2.32	157	B	....do	Cap Island	C
513	...do...	Dot Island	55	54	133	20	N	T	450	10	.93	189	B	Deweyville	Sheltered	....
514	...do...	Deweyville	55	55	133	19	N	T	150	150	4.65	945	A	....do	....do	....
515	...do...	....do	55	56	133	18	N	T	100	50	1.03	210	A	....do	....do	....
[2] 516	...do...	....do	55	58	133	18	N	T	16,050	10	33.16	8,009	B	....do	....do	....
[2] 517	...do...	....do	55	57	133	21	N	T	7,000	15	21.69	3,856	B	....do	....do	....
518	...do...	Hoot Island	55	55	133	22	N	T	200	100	4.13	840	B	....do	....do	....
519	...do...	....do	55	54	133	22	N	VT	300	100	6.20	420	C	Karheen	....do	....
520	...do...	....do	55	53	133	23	N	VT	200	100	4.13	280	A	....do	....do	....
521	...do...	Owl Island	55	53	133	25	N	M	200	25	1.03	315	B	....do	....do	....
522	...do...	Sea Otter Sound	55	54	133	28	Mac	M	600	20	2.48	240	B	Marble Bay	Marble Bay	....
523	...do...	....do	55	54	133	29	N	H	450	30	2.79	1,710	A	....do	....do	....
524	...do...	Eagle Island	55	52	133	31	N	VT	6,700	500	692.15	26,654	A	Port Alice	....do	....
525	...do...	White Cliff Island	55	55	133	30	N	MH	2,000	12	4.96	2,180	B	Marble Bay	....do	....
526	...do...	Edna Bay	55	56	133	38	N	T	150	20	.62	126	A	Edna Bay	Edna Bay	....
527	...do...	....do	55	55	133	38	0.8 Mac, .2 N	T	1,550	15	4.80	428	B	....do	....do	....
528	...do...	Green Island	55	55	133	37	0.1 Mac, .9 N	VT	4,000	100	82.64	5,240	B	....do	....do	....
529	...do...	....do	55	54	133	38	N	T	400	250	20.66	4,200	A	....do	....do	....
530	...do...	Edna Bay	55	55	133	40	N	VT	2,200	100	45.45	3,080	A	....do	....do	....
531	...do...	Cosmos Pass	55	54	133	42	N	T	2,600	50	26.86	5,460	B	....do	....do	....
532	...do...	Whale Head	55	53	133	39	N	VT	800	100	16.53	1,120	B	Port Alice	Port Alice	....
533	...do...	....do	55	52	133	42	0.1 Mac, .9 N	VT	8,900	900	1,654.98	110,885	C	....do	....do	....
534	...do...	Black Rock	55	52	133	46	N	VT	1,700	100	35.12	2,380	B	Warren Cove	Halibut Harbor	....
535	...do...	Halibut Harbor	55	54	133	44	0.1 Mac, .9 N	VT	3,300	440	300.00	18,816	A	....do	....do	....
536	...do...	....do	55	54	133	47	N	VT	4,450	1,300	1,195.30	80,085	A	....do	....do	....
537	...do...	Cape Pole	55	56	133	49	N	MH	6,000	60	74.38	35,460	A	Pole Anchorage	Pole Anchorage	....
538	...do...	Warren Island	55	56	133	51	0.1 Al, .9 N	H	9,325	45	86.69	55,228	B	....do	Warren Cove	....
539	...do...	....do	55	53	133	51	N	M	3,100	15	9.60	3,248	B	Warren Cove	....do	....
540	...do...	....do	55	51	133	52	N	T	5,775	130	155.11	31,487	B	....do	....do	....
541	...do...	....do	55	51	133	54	N	T	3,350	8	5.54	1,125	C	....do	....do	....

[1] There are numerous unsurveyed islands in the vicinity, which are not on the map. Their shores have kelp on them, and the total estimate is given as bed No. 476.

[2] Beds No. 516 and 517 are shore fringes about inaccurately surveyed groups of islands. The exact limits and number of islands can not be shown, but the kelp is roughly located, and its area and tonnage estimated.

TABLE XXXII.—*Location, area, and tonnage of the surveyed kelp beds of southeast Alaska*—Continued.

Bed No.	Sheet.	Vicinity.	Latitude.	Longitude.	Kind.	Density.	Length.	Width.	Area.	Estimated tonnage.	Availability.	Nearest deep harbor.	Nearest shelter.	Fish industry at harbor.
			° ′	° ′			*Yards.*	*Yards.*	*Acres.*	*Tons.*				
542	F	Warren Island	55 53	133 57	N	MH	10,750	80	177.69	84,080	C	Warren Cove	Warren Cove	
543	do	do	55 56	133 55	N	T	500	75	7.75	1,573	A	Pole Anchorage	do	
544	E & F	Point Hardscrabble	56 00	133 47	0.1 Al, .9 N	VH	10,000	200	413.20	309,000	A	do	Pole Anchorage	
545	do	Ruins Point	56 04	133 40	0.1 Al, .9 N	MH	11,400	130	306.20	135,656	A	Shipley Bay	Shipley Bay	
546	do	Shipley Bay	56 05	133 36	0.9 Al, .1 N	M	1,550	10	3.20	304	B	do	do	
547	do	do	56 05	133 33	N	T	300	10	.62	126	B	do	do	
548	do	do	56 05	133 38	N	VH	175	175	6.30	4,731	A	do	do	
549	do	Bluff Island	56 06	133 40	0.2 Al, .8 N	MH	1,250	800	206.61	90,296	B	do	do	
550	do	Shipley Bay	56 07	133 38	0.1 Al, .9 N	MH	4,850	140	140.29	59,956	A	do	do	
551	do	Shakan Bay	56 08	133 39	N	T	1,550	100	32.02	2,145	A	Shakan Bay	Shakan Bay	
552	do	do	56 09	133 38	N	T	2,500	525	262.09	17,600	A	do	do	
553	do	do	56 09	133 37	N	MH	1,100	150	34.09	16,280	A	do	do	
554	do	do	56 08	133 36	N	VT	1,750	40	14.46	980	B	do	do	
555	do	do	56 08	133 34	N	T	700	100	14.46	2,940	B	do	do	
556	do	Hamilton Island	56 08	133 33	N	T	3,350	10	6.92	1,407	B	do	do	
557	do	do	56 08	133 32	N	T	2,000	15	6.20	1,260	B	do	do	
558	do	Shakan Bay	56 09	133 33	N	M	750	450	69.80	23,660	B	do	do	
559	do	Middle Island	56 09	133 32	N	T	2,200	5	2.27	462	B	do	do	
560	do	Shakan Bay	56 10	133 33	N	T	1,000	350	72.31	14,679	C	do	do	
561	do	do	56 10	133 34	N	M	500	75	7.75	2,625	B	do	do	
562	do	Middle Island	56 10	133 33	N	T	300	100	6.20	1,260	B	do	do	
563	do	Shakan Bay	56 11	133 34	N	MH	1,550	50	16.01	7,646	B	do	do	
564	do	do	56 11	133 36	N	M	2,900	450	269.63	91,155	B	do	do	
565	do	do	56 10	133 37	N	T	1,550	400	128.10	26,040	A	do	do	
566	do	do	56 11	133 38	N	M	75	50	.77	267	A	do	Barrier Islands	
567	do	Barrier Islands	56 12	133 40	N	MH	1,300	400	107.43	51,220	A	do	do	
568	do	do	56 13	133 40	0.1 Al, .9 N	VT	6,900	1,370	1,953.10	129,604	B	do	do	
569	do	do	56 14	133 37	0.7 Al, .3 N	VT	3,300	150	102.27	2,203	B	do	Hole-in-the-Wall	
570	do	Calder Rocks	56 15	133 42	N	T	1,550	20	64.05	4,291	B	do	do	
571	do	Hole in the Wall	56 16	133 38	0.2 Al, .8 N	T	5,300	54	59.12	10,631	D	Labouchere Bay	do	
572	do	Labouchere Island	56 18	133 40	N	MH	600	10	1.24	588	C	do	Labouchere Bay	
573	do	Labouchere Bay	56 17	133 39	Al	VT	880	400	72.73	246	C	do	do	
574	do	do	56 18	133 38	Al	H	400	30	2.48	76	A	do	do	

575	...do...	.....do	56	18	133	37	Al	H	800	20	3.30	100	C	.....do	.....do	....
576	...do...	.....do	56	18	133	38	Al	H	2,650	5	2.74	82	C	.....do	.....do	....
577	...do...	.....do	56	18	133	39	{0.6 Al {0.4 N	M	400	100	8.26	1,206	B	.....do	.....do	....
578	E.....	Port Protection	56	19	133	38	{0.4 Al {.6 N	M	2,600	5	2.68	566	C	Port Protection	Port Protection	....
579	E & F.	.....do	56	19	133	37	Al	H	200	50	2.07	64	A	.....do	.....do	....
580	...do...	.....do	56	19	133	36	Al	M	1,300	400	107.44	1,827	A	.....do	.....do	....
581	E.....	.....do	56	19	133	36	Al	MH	800	10	1.65	39	B	.....do	.....do	....
582	...do...	.....do	56	20	133	37	N	H	100	20	0.41	252	A	.....do	Point Baker	....
583	...do...	Point Baker	56	21	133	36	{0.5 Al {.5 N	VH	10,000	12	24.79	14,135	B	.....do	.....do	....
584	...do...	Strait Island	56	21	133	42	{0.4 Al {.6 N	H	4,900	50	50.62	19,258	B	.....do	.....do	....
585	...do...	Shoal Cove	56	20	133	30	{0.9 Al {.1 N	H	8,000	10	16.53	1,890	B	.....do	Shoal Cove	....
586	...do...	.....do	56	20	133	23	Al	H	6,100	75	94.53	6,000	A	Red Bay	.....do	....
587	...do...	Red Bay	56	20	133	20	{0.9 Al {.1 N	MH	3,000	40	24.79	2,926	A	.....do	Red Bay	....
588	...do...	Dead Island	56	19	133	18	Al	T	300	100	6.20	217	C	.....do	.....do	....
589	...do...	Pine Point	56	20	133	16	Al	MH	3,800	25	19.63	465	B	.....do	.....do	....
590	...do...	Point Colpoys	56	20	133	12	{0.9 Al {.1 N	MH	2,900	40	23.97	10,354	B	.....do	Colpoys Anchorage	....
591	...do...	.....do	56	20	133	09	N	M	375	100	7.75	2,625	A	Exchange Cove	Salmon Bay	....
592	...do...	Salmon Bay	56	19	133	09	{0.5 Al {.5 N	T	4,000	20	16.53	580	B	.....do	.....do	....
593	...do...	Rookery Islands	56	19	133	07	N	T	1,350	20	5.58	1,134	B	.....do	.....do	....
594	...do...	Salmon Bay	56	18	133	08	{0.8 Al {.2 N	VT	1,550	60	19.22	1,042	B	.....do	.....do	....
595	...do...	.....do	56	16	133	07	Al	M	4,400	30	27.27	461	B	.....do	.....do	....
596	...do...	Tide Island	56	17	133	03	N	M	400	15	1.24	419	B	.....do	.....do	....
597	...do...	Exchange Cove	56	15	133	04	Al	MH	2,450	30	15.19	350	A	.....do	Exchange Cove	....
598	...do...	.....do	56	14	133	04	Al	M	1,100	25	5.68	95	B	.....do	.....do	....
599	...do...	Fire Island	56	14	133	03	N	T	1,100	15	3.40	693	B	.....do	.....do	....
600	...do...	Exchange Cove	56	13	133	04	Al	MH	1,000	20	4.13	100	B	.....do	.....do	....
601	...do...	Exchange Island	56	12	133	03	N	M	1,300	30	8.06	2,730	C	.....do	.....do	....
602	...do...	Exchange Cove	56	12	133	01	{0.3 Al {.7 N	M	400	8	.66	60	C	.....do	Middle Islands	....
603	...do...	West Island	56	11	133	00	{0.2A {.8N	T	2,000	4	1.65	422	B	.....do	.....do	....
604	...do...	Middle Islands	56	10	132	58	N	M	200	20	.83	280	C	.....do	.....do	....
605	...do...	.....do	56	10	132	57	{0.5A {.5N	MH	2,350	12	5.83	386	B	.....do	.....do	....
606	...do...	Blashke Island	56	08	132	57	N	VT	800	20	3.30	224	B	Lake Bay	Sheltered	C
607	...do...	East Island	56	09	132	54	N	T	5,632	140	162.91	33,116	B	.....do	Blashke Island	C
608	...do...	Blashke Island	56	07	132	54	N	VT	3,500	7	5.06	679	B	.....do	.....do	C
609	...do...	.....do	56	07	132	52	N	T	8,000	100	165.29	33,553	B	.....do	.....do	C
610	...do...	Rose Rock	56	05	132	52	N	T	250	20	1.03	210	B	.....do	.....do	C
611	...do...	Rose Island	56	05	132	51	N	M	700	17	2.46	776	B	.....do	.....do	C
612	...do...	Point Barnes	56	04	132	55	N	T	350	10	.72	147	B	.....do	Lake Bay	C
613	...do...	Lake Bay	56	03	132	54	N	MH	150	30	.85	442	A	.....do	.....do	C
614	...do...	.....do	56	03	132	52	N	M	400	10	.83	280	A	.....do	.....do	C

TABLE XXXII.—*Location, area, and tonnage of the surveyed kelp beds of southeast Alaska*—Continued.

Bed No.	Sheet.	Vicinity.	Latitude.	Longitude.	Kind.	Density.	Length.	Width.	Area.	Estimated tonnage.	Availability.	Nearest deep harbor.	Nearest shelter.	Fish industry at harbor.
			° ′	° ′			*Yards.*	*Yards.*	*Acres.*	*Tons.*				
615	E	The Triplets	56 04	132 50	N	VT	1,360	100	28.10	1,904	B	Lake Bay	Lake Bay	C
616	do	Coffman Island	56 02	132 51	N	T	1,475	10	3.04	899	B	do	Coffman Cove	C
617	do	Coffman Cove	56 01	132 48	N	T	680	5	.70	143	C	do	do	C
618	do	Luck Point	56 00	132 46	N	T	100	50	1.03	210	B	do	do	C
619	do	do	55 59	132 44	N	T	600	25	3.10	630	C	do	do	C
620	do	Stanhope Island	56 03	132 39	N	T	800	5	.83	168	B	Burnett Inlet	Rocky Bay	C
621	do	Abraham Island	56 03	132 40	N	VT	400	10	.83	56	C	do	do	C
622	do	Stikine Strait	56 15	132 44	N	T	200	15	.62	126	B	Quiet Harbor	Quiet Harbor	
623	do	Point Nesbitt	56 14	132 52	N	M	2,500	5	2.58	875	C	Exchange Cove	Middle Islands	
624	do	Nesbitt Reef	56 13	132 51	N	M	300	20	1.24	420	C	do	do	
625	do	Bluff Island	56 10	132 52	N	T	2,700	3	1.67	113	C	do	do	
626	do	Middle Islands	56 11	132 55	N	M	400	10	.83	280	B	do	do	
627	do	do	56 11	132 55	N	M	4,425	10	9.14	1,680	B	do	Sheltered	
628	do	do	56 11	132 58	0.1A .9N	T	825	3	.51	50	B	do	do	
629	do	do	56 12	132 58	0.1A .9N	T	825	3	.51	50	B	do	do	
630	do	do	56 12	132 57	N	MH	1,800	35	13.02	6,342	A	do	do	
631	do	do	56 12	132 59	N	VT	2,000	75	30.99	2,100	B	do	Middle Islands	
632	do	do	56 13	133 00	N	T	850	20	3.51	1,134	B	do	do	
633	do	Exchange Cove	56 13	133 02	N	M	1,500	20	6.20	2,100	C	do	Exchange Cove	
634	do	Echo Island	56 14	133 01	0.5A .5N	M	2,200	15	6.82	1,175	B	do	do	
635	do	Shrubby Island	56 14	132 58	0.3A .7N	M	17,150	15	53.15	7,711	B	do	Middle Islands	
636	do	Bushy Island	56 15	132 57	0.1A .9N	VT	2,440	540	272.19	27,496	A	do	do	
637	do	Snow Passage	56 15	132 54	0.6A .4N	VT	2,000	70	28.90	852	B	do	do	
638	do	Bushy Island	56 16	132 59	0.2 Al .8 N	M	8,800	60	109.09	29,906	B	do	do	
639	do	Snow Passage	56 17	132 58	0.6 Al .4 N	M	6,000	24	29.75	5,000	B	do	do	
640	do	McNamara Point	56 19	133 02	Al	T	250	50	2.58	17	B	St. John Harbor.	Salmon Bay	
641	do	do	56 20	133 03	0.7 Al .3 N	T	1,100	30	6.82	463	B	do	do	
642	do	do	56 21	133 04	0.9 Al. .1 N	T	2,300	50	23.76	695	A	do	do	
643	do	Point St. John	56 23	133 02	0.9 Al .1 N	T	4,400	2	1.82	335	B	do	St. John Harbor	

644	...do...	.....do	56	24	133	01	0.2 Al, .8 N	T	2,000	165	68.18	11,223	A	.....do	.....do	
645	...do...	Vichnefski Rock	56	26	133	00	N	T	950	142	27.87	5,100	B	.....do	.....do	
646	...do...	Zimovia Strait	56	12	132	15	N	VT	400	25	2.07	200	C	Olive Cove	Sheltered	
647	...do...	White Rock	56	29	133	01	N	M	100	20	.42	140	B	St. John Harbor.	St. John Harbor	
648	...do...	Level Island	56	28	133	04	N	VT	4,700	100	97.10	6,580	A	.....do	.....do	
649	...do...	.....do	56	27	133	06	N	M	1,300	10	2.69	910	B	.....do	.....do	
650	...do...	.....do	56	27	133	07	N	T	200	50	2.07	420	A	.....do	.....do	
651	...do...	Kah Sheets Bay	56	29	133	07	N	VT	5,500	15	17.05	1,151	A	.....do	Kah Sheets Bay	
652	...do...	Mitchell Point	56	28	133	09	0.7 Al, .3 N	M	400	20	1.65	187	A	.....do	.....do	
653	...do...	.....do	56	26	133	09	0.6 N, .4 Al	T	200	100	4.13	510	A	.....do	Douglas Bay	
654	...do...	.....do	56	27	133	11	0.5 Al, .5 N	M	4,450	710	652.79	115,803	A	Totem Bay	.....do	
655	...do...	.....do	56	26	133	12	0.3 Al, .7 N	VH	150	100	3.10	1,658	A	.....do	.....do	
656	...do...	Douglas Bay	56	27	133	14	0.6 Al, .4 N	M	300	150	9.30	1,353	A	.....do	.....do	
657	...do...	.....do	56	27	133	17	0.9 Al, .1 N	T	300	40	2.48	72	A	.....do	.....do	
658	...do...	.....do	56	28	133	17	Al	M	500	20	2.07	36	B	.....do	.....do	
659	...do...	.....do	56	27	133	18	N	M	100	75	1.55	455	A	.....do	.....do	
660	...do...	.....do	56	28	133	20	0.1 Al, .9 N	VT	3,265	100	67.46	2,044	A	.....do	.....do	
661	...do...	Totem Bay	56	28	133	21	0.7 Al, .3 N	T	350	220	15.91	3,200	A	.....do	Totem Bay	
662	...do...	.....do	56	27	133	23	0.8 Al, .2 N	T	950	50	9.81	456	A	.....do	.....do	
663	...do...	.....do	56	28	133	24	0.5 Al, .5 N	VT	2,600	100	53.72	1,911	A	.....do	.....do	
664	...do...	.....do	56	27	133	25	Al	VT	650	20	2.68	9	B	.....do	.....do	
665	...do...	Shingle Island	56	27	133	24	0.2 Al, .8 N	T	400	110	9.09	1,592	A	.....do	.....do	
666	...do...	.....do	56	26	133	23	0.3 Al, .7 N	VT	700	40	5.79	280	B	.....do	.....do	
667	...do...	Totem Bay	56	26	133	25	0.4 Al, .6 N	VT	600	300	37.19	1,982	A	.....do	.....do	
668	...do...	.....do	56	26	133	26	0.6 Al, .4 N	VT	2,700	100	55.78	1,605	A	.....do	.....do	
669	...do...	.....do	56	27	133	27	Al	M	2,200	5	2.27	38	B	.....do	.....do	
670	...do...	.....do	56	27	133	29	0.4 Al, .6 N	M	1,800	4	1.49	206	B	.....do	.....do	
671	...do...	.....do	56	26	133	28	0.8 Al, .2 N	M	150	100	3.10	838	A	.....do	.....do	
672	...do...	.....do	56	26	133	29	0.6 Al, .4 N	VT	1,310	200	54.13	400	A	.....do	.....do	
673	...do...	Point Barrie	56	26	133	30	0.9 Al, .1 N	VT	2,200	50	22.73	223	B	.....do	.....do	
674	...do...	.....do	56	25	133	31	0.8 Al, .2 N	VT	800	30	4.96	80	A	.....do	.....do	

TABLE XXXII.—*Location, area, and tonnage of the surveyed kelp beds of southeast Alaska*—Continued.

Bed No.	Sheet.	Vicinity.	Latitude.	Longitude.	Kind.	Density.	Length.	Width.	Area.	Estimated tonnage.	Availability.	Nearest deep harbor.	Nearest shelter.	Fish industry at harbor.
			° ′	° ′			*Yards.*	*Yards.*	*Acres.*	*Tons.*				
675	E	Point Barrie	56 25	133 32	0.1 Al, .9 N	M	300	20	1.24	380	A	Totem Bay	Totem Bay	
676	do	do	56 26	133 36	0.7 Al, .3 N	T	9,000	153	284.50	19,200	A	do	Point Barrie	
677	do	do	56 27	133 41	0.2 Al, .8 N	M	200	75	3.10	844	A	Seclusion Harbor.	do	
678	do	do	56 27	133 40	N	M	1,000	100	20.66	6,634	A	do	do	
679	do	do	56 27	133 39	0.6 Al, .4 N	M	4,372	110	99.36	14,000	B	do	do	
680	do	do	56 29	133 40	0.5 Al, .5 N	T	3,550	450	330.06	35,000	A	do	do	
681	do	do	56 30	133 40	0.6 Al, .4 N	M	150	30	.93	135	A	do	do	
682	do	Shallow Bay	56 30	133 40	0.1 Al, .9 N	MH	100	20	.41	278	A	do	Shallow Bay	
683	do	do	56 30	133 42	Al	MH	1,390	35	10.05	4,871	B	do	do	
684	do	do	56 30	133 42	Al	T	500	100	10.30	102	A	do	do	
685	do	do	56 31	133 40	0.8 Al, .2 N	T	2,620	30	16.24	825	B	do	do	
686	do	do	56 31	133 41	0.7 Al, .3 N	M	300	250	15.50	1,756	A	do	do	
687	do	do	56 31	133 43	Al	MH	100	30	.63	15	B	do	Crooked Island	
688	do	do	56 32	133 43	N	VT	400	100	8.26	560	A	do	do	
689	do	do	56 32	133 40	0.6 Al, .4 N	VT	1,510	300	9.36	273	A	do	Shallow Bay	
690	do	do	56 33	133 42	0.7 Al, .3 N	VT	4,000	300	247.93	5,656	B	do	do	
691	do	Three Mile Arm	56 33	133 45	0.2 Al, .8 N	VT	3,550	150	110.02	5,982	B	do	Crooked Island	
692	do	Crooked Island	56 31	133 45	0.6 Al, .4 N	VT	4,000	360	297.52	8,666	B	do	do	
693	do	do	56 33	133 45	0.6 Al, .4 N	M	100	100	2.07	305	A	do	do	
694	do	Three Mile Arm	56 33	133 47	0.1 Al, .9 N	VT	3,100	100	64.05	3,877	B	do	do	
695	do	do	56 33	133 47	0.1 Al, .9 N	M	50	50	.51	24	A	do	Seclusion Harbor	
696	do	do	56 33	133 47	0.5 Al, .5 N	VT	600	20	2.48	88	C	do	Crooked Island	
697	do	do	56 34	133 48	N	VT	200	100	4.13	280	B	do	Three Mile Arm	
698	do	Seclusion Harbor	56 34	133 50	N	VT	100	100	2.07	140	B	do	Seclusion Harbor	

699	...do...	.....do	56	32	133	50	0.1 Al, .9 N	T	760	25	3.92	503	B	.....do	.....do	....
700	...do...	Conclusion Island	56	29	133	49	0.4 Al, .6 N	M	2,000	4	1.65	45	B	.....do	Lonely Islands	....
701	...do...	.....do	56	28	133	46	0.8 Al, .2 N	M	6,775	5	7.00	691	B	.....do	.....do	....
702	...do...	Lonely Islands	56	28	133	51	0.6 Al, .4 N	VT	1,700	10	3.51	26	C	.....do	.....do	....
703	...do...	.....do	56	28	133	50	0.9 Al, .1 N	VT	250	100	5.10	49	A	.....do	.....do	....
704	...do...	.....do	56	28	133	50	0.7 Al, .3 N	VT	3,550	10	7.33	166	B	.....do	.....do	....
705	...do...	.....do	56	27	133	50	0.9 Al, .1 N	VT	5,600	90	104.13	521	B	Reids Bay	.....do	....
706	...do...	Sumner Island	56	26	133	48	Al	T	400	60	4.96	57	B	.....do	Sumner Island	....
707	...do...	.....do	56	25	133	47	0.9 Al, .1 N	M	14,150	10	29.24	1,423	C	.....do	.....do	....
708	...do...	.....do	56	24	133	46	0.9 Al, .1 N	T	1,300	10	2.69	70	B	.....do	.....do	....
709	...do...	.....do	56	23	133	50	0.9 Al, .1 N	M	300	25	1.55	65	B	.....do	Reids Bay	....
710	...do...	.....do	56	26	133	49	0.9 Al, .1 N	M	400	15	1.24	44	C	.....do	Sumner Island	....
711	...do...	Alvin Bay	56	26	133	51	Al	M	5,325	8	8.80	147	C	.....do	Alvin Bay	....
712	...do...	.....do	56	26	133	53	Al	M	3,100	5	3.20	53	B	.....do	.....do	....
713	...do...	Reids Bay	56	24	133	52	Al	MH	7,326	5	7.56	176	C	.....do	Reids Bay	....
714	...do...	.....do	56	23	133	54	Al	M	3,100	5	3.20	53	C	.....do	.....do	....
715	...do...	.....do	56	22	133	53	Al	M	100	75	1.55	26	A	.....do	.....do	....
716	...do...	.....do	56	22	133	53	Al	MH	3,775	10	7.80	192	C	.....do	.....do	....
717	E & F.	.....do	56	20	133	50	0.7 Al, .3 N	H	20,750	30	128.62	28,848	B	.....do	.....do	....
718	...do...	Port Beauclerc	56	20	133	55	0.9 Al, .1 N	MH	9,330	4	7.71	762	B	Port Beauclerc.	Port Beauclerc	C
719	E	.....do	56	22	133	58	Al	M	400	5	.41	7	B	.....do	.....do	C
720	D & E.	.....do	56	22	133	59	Al	T	1,000	10	2.06	34	B	.....do	.....do	C
721	...do...	.....do	56	20	133	59	0.1 Al, .9 N	T	1,600	6	1.99	105	B	.....do	.....do	C
722	E & F.	.....do	56	18	133	56	0.4 Al, .6 N	VT	3,775	2	1.56	64	D	.....do	.....do	C
723	...do...	.....do	56	16	133	51	0.8 Al, .2 N	H	1,600	25	8.26	1,187	C	.....do	.....do	C
724	...do...	.....do	56	14	133	53	0.9 Al, .1 N	MH	9,780	2	4.04	276	D	.....do	.....do	C
725	...do...	Point Amelius	56	13	133	52	0.8 Al, .2 N	M	600	15	1.86	15	C	.....do	Moccasin Cove	C
726	...do...	.....do	56	12	133	54	0.9 Al, .1 N	M	2,500	10	5.17	253	C	.....do	.....do	C
727	...do...	.....do	56	12	133	52	0.4 Al, .6 N	H	900	40	7.44	4,600	C	.....do	.....do	C
728	...do...	.....do	56	11	133	52	0.3 Al, .7 N	MH	1,400	10	2.90	1,086	C	.....do	.....do	C
729	...do...	Moccasin Cove	56	12	133	56	0.9 Al, .1 N	MH	4,070	5	4.20	583	D	.....do	.....do	C

TABLE XXXII.—*Location, area, and tonnage of the surveyed kelp beds of southeast Alaska*—Continued.

Bed No.	Sheet.	Vicinity.	Latitude.	Longitude.	Kind.	Density.	Length.	Width.	Area.	Estimated tonnage.	Availability.	Nearest deep harbor.	Nearest shelter.	Fish industry at harbor.
			° ′	° ′			*Yards.*	*Yards.*	*Acres.*	*Tons.*				
730	E & F.	Moccasin Cove	56 11	133 56	0.7 Al .3 N	M	500	6	.62	70	C	Port Beauclerc.	Moccasin Cove	C
731	do	do	56 10	133 56	0.9 Al .1 N	MH	5,100	8	8.40	577	C	do	do	C
732	do	do	56 10	133 54	0.3 Al .7 N	M	1,000	75	15.50	1,798	B	do	do	C
733	do	Grebe Cove	56 09	133 55	0.9 Al .1 N	MH	200	100	4.13	302	B	do	Grebe Cove	C
734	do	do	56 09	133 56	0.9 Al .1 N	VH	3,600	40	29.75	3,278	C	do	do	C
735	do	do	56 09	133 54	0.5 Al .5 N	M	1,100	100	22.73	4,026	B	do	do	C
736	do	do	56 08	133 53	0.7 Al .3 N	H	800	500	82.62	16,722	B	do	do	C
737	do	do	56 08	133 54	0.2 Al .8 N	M	1,500	400	123.97	34,014	B	do	do	C
738	do	do	56 08	133 57	0.8 Al .2 N	H	1,000	60	12.40	1,600	B	Port McArthur.	do	
739	do	Point St. Albans	56 05	133 56	N	M	2,200	1,000	454.54	153,621	A	do	do	
740	do	do	56 05	134 00	N	T	12,400	400	1,024.79	231,000	B	do	do	
741	D, E, & F.	Afleck Canal	56 08	134 02	N	T	8,650	7	12.51	2,541	B	Kell Bay	Inside Cove	
742	do	Inside Cove	56 10	134 03	N	M	600	150	18.60	6,300	A	do	do	
743	do	do	56 12	134 03	N	M	4,450	5	4.56	1,557	B	Bear Harbor	do	
744	do	Afleck Canal	56 14	134 04	N	VT	1,100	3	.68	46	C	do	Bear Harbor	
745	do	do	56 15	134 03	N	VT	850	15	2.63	150	B	do	do	
746	do	do	56 18	134 04	N	VT	2,070	50	21.38	321	A	do	do	
747	do	do	56 16	134 04	N	VT	650	6	.80	13	B	do	do	
748	do	do	56 15	134 04	N	M	1,050	8	1.74	582	B	do	do	
749	do	Bear Harbor	56 14	134 05	N	VT	1,775	8	1.73	199	B	do	do	
750	do	Afleck Canal	56 11	134 06	N	VT	2,855	10	5.90	434	B	Kell Bay	Kell Bay	
751	do	Kell Bay	56 10	134 08	N	VT	1,350	30	8.37	214	B	do	do	
752	do	do	56 10	134 10	N	VT	500	100	10.33	692	A	do	do	
753	do	do	56 09	134 09	N	VT	300	100	6.20	375	B	do	do	
754	do	Bush Islets	56 08	134 06	N	T	3,350	25	17.30	3,512	B	do	do	
755	E & F.	Marble Island	56 07	134 06	N	M	900	15	2.79	800	B	Port McArthur.	Port McArthur	
756	do	Port McArthur	56 05	134 06	N	M	4,300	80	71.07	20,553	B	do	do	
757	do	do	56 04	134 08	N	VT	1,775	10	3.67	257	B	do	do	
758	do	do	56 04	134 08	N	MH	100	50	1.03	492	A	do	do	
759	do	North Island	56 04	134 06	N	T	2,650	650	355.89	60,000	B	do	do	
760	do	Fairway Island	56 02	134 03	N	VT	2,450	750	379.65	24,083	B	do	do	

761	...do...	Cape Decision	56	01	134	12	N	M	24,660	205	1,044.48	30,334	C	Port Wylie	Port Wylie	
762	F	Spanish Islands	55	59	134	08	N	T	8,440	335	584.17	118,570	B	Aats Bay	Aats Bay	
763	...do...	Coronation Island	55	53	134	10	N	VT	11,100	4	9.17	622	D	...do...	...do...	
764	...do...	...do...	55	51	134	16	N	VT	900	10	1.86	126	D	...do...	Port Elizabeth	
765	...do...	Port Elizabeth	55	51	134	20	N	M	1,700	15	5.27	1,785	C	Port Elizabeth	...do...	
766	...do...	...do...	55	52	134	20	N	M	3,500	150	108.47	36,450	C	...do...	...do...	
767	...do...	Egg Harbor	55	55	134	20	{0.3 Al, .7 N}	M	2,600	25	13.43	3,211	B	Egg Harbor	Egg Harbor	
768	...do...	...do...	55	55	134	19	Al	MH	300	30	1.86	43	B	...do...	...do...	
769	...do...	Aats Point	55	56	134	18	{0.2 Al, .8 N}	M	7,000	25	36.16	9,902	B	...do...	...do...	
770	...do...	...do...	55	57	134	16	N	M	1,000	600	123.97	41,912	A	...do...	...do...	
771	...do...	Aats Bay	55	53	134	16	Al	T	1,350	4	1.12	18	C	Aats Bay	Aats Bay	
772	...do...	...do...	55	53	134	15	{0.4 Al, .6 N}	M	2,500	15	7.74	2,095	B	...do...	...do...	
773	...do...	...do...	55	54	134	15	N	M	75	75	1.16	391	A	...do...	...do...	
774	...do...	...do...	55	54	134	14	{0.1 Al, .9 N}	M	4,100	55	46.59	14,422	A	...do...	...do...	
775	...do...	Cora Point	55	55	134	10	N	T	7,280	165	248.18	50,372	B	...do...	...do...	
776	...do...	Point Howard	56	06	134	14	N	T	4,660	15	14.44	2,920	D	Port McArthur	Port Wylie	
777	...do...	Point Crowley	56	07	134	15	N	MH	1,550	100	32.02	10,339	D	...do...	...do...	
778	D & F.	Crowley Bay	56	09	134	13	N	T	9,330	15	28.91	6,048	D	Port Malmesbury.	Crowley Bay	
779	...do...	...do...	56	10	134	15	N	M	3,100	300	192.14	65,100	C	...do...	...do...	
780	...do...	Port Malmesbury	56	13	134	15	N	T	10,400	90	193.39	39,312	D	...do...	Port Malmesbury	
781	...do...	...do...	56	16	134	15	N	T	1,800	15	5.58	1,124	C	...do...	...do...	
782	...do...	...do...	56	17	134	13	N	T	2,400	10	4.96	1,008	B	...do...	...do...	
783	...do...	...do...	56	18	134	15	N	T	3,100	3	1.92	391	C	...do...	...do...	
784	...do...	Point Harris	56	18	134	18	N	T	8,800	12	20.99	6,314	C	...do...	...do...	
785	D	Point Cosmos	56	20	134	16	N	VT	1,550	890	285.02	18,980	B	...do...	Gedney Harbor	
786	...do...	...do...	56	21	134	17	N	H	6,200	50	64.05	39,160	C	...do...	...do...	
787	...do...	Gedney Harbor	56	22	134	16	N	H	230	80	3.80	2,319	B	Tebenkof Bay	...do...	
788	...do...	...do...	56	23	134	15	N	MH	4,400	40	36.36	17,336	C	...do...	...do...	
789	...do...	...do...	56	24	134	16	N	MH	3,300	200	136.36	64,680	C	...do...	...do...	
790	...do...	Tebenkof Bay	56	26	134	14	N	M	10,650	60	132.02	62,638	C	...do...	Tebenkof Bay	
791	...do...	...do...	56	27	134	10	N	M	4,500	10	9.30	3,010	B	...do...	...do...	
792	...do...	...do...	56	29	134	15	N	M	1,750	100	36.15	12,250	C	...do...	...do...	
793	...do...	...do...	56	29	134	13	{0.1 Al, .9 N}	M	3,000	60	37.19	11,402	B	...do...	...do...	
794	...do...	...do...	56	30	134	13	N	T	500	200	20.66	4,200	B	...do...	...do...	
795	...do...	...do...	56	29	134	11	{0.1 Al, .9 N}	M	7,000	50	72.31	22,150	B	...do...	...do...	
796	...do...	...do...	56	27	134	09	N	VT	7,750	10	16.01	542	B	...do...	...do...	
797	...do...	...do...	56	31	134	10	N	T	4,200	3	2.60	519	D	...do...	...do...	
798	...do...	...do...	56	33	134	15	N	T	8,000	15	24.79	4,940	C	...do...	...do...	
799	...do...	Point Ellis	56	33	134	18	N	T	1,100	10	2.27	462	D	Bay of Pillars	Bay of Pillars	C
800	...do...	...do...	56	34	134	20	N	M	1,750	150	54.23	18,375	B	...do...	...do...	C
801	...do...	...do...	56	34	134	18	{0.2 Al, .8 N}	MH	5,000	20	20.66	7,936	B	...do...	...do...	C
802	...do...	Bay of Pillars	56	36	134	16	{0.4 Al, .6 N}	M	3,100	15	9.60	2,018	B	...do...	...do...	C
803	...do...	...do...	56	37	134	13	N	T	1,550	40	12.80	2,604	C	...do...	...do...	C

TABLE XXXII.—*Location, area, and tonnage of the surveyed kelp beds of southeast Alaska*—Continued.

Bed No.	Sheet.	Vicinity.	Latitude.	Longitude.	Kind.	Density.	Length.	Width.	Area.	Estimated tonnage.	Availability.	Nearest deep harbor.	Nearest shelter.	Fish industry at harbor.
			° ′	° ′			*Yards.*	*Yards.*	*Acres.*	*Tons.*				
804	D	Bay of Pillars	56 37	134 13	N	T	2,200	5	2.27	462	C	Bay of Pillars	Bay of Pillars	C
805	do	do	56 37	134 14	N	T	3,300	4	2.73	543	C	do	do	C
806	do	do	56 36	134 18	N	M	2,450	150	75.93	25,725	C	do	do	C
807	do	do	56 36	134 20	N	VT	400	10	.83	56	C	do	do	C
808	do	do	56 37	134 17	0.2 Al, .8 N	MH	5,775	150	178.98	68,747	C	do	do	C
809	do	do	56 39	134 16	N	VT	2,700	10	5.58	189	B	do	do	C
810	do	do	56 39	134 16	N	VT	2,000	14	5.79	229	B	do	do	C
811	do	do	56 38	134 20	N	M	100	75	1.55	525	B	do	do	C
812	do	do	56 39	134 20	N	MH	1,000	150	30.99	15,756	A	do	do	C
813	do	Point Sullivan	56 40	134 22	0.1 Al, .9 N	MH	12,830	125	331.35	156,720	C	do	do	C
814	do	Washington Bay	56 44	134 24	0.1 Al, .9 N	M	2,050	30	12.70	3,885	C	Washington Bay.	Washington Bay	
815	do	Kingsmill Point	56 49	134 24	0.2 Al, .8 N	MH	14,300	20	59.09	22,721	C	Security Bay	Security Bay	
816	do	Security Bay	56 52	134 22	N	M	3,050	20	12.60	4,259	B	do	do	
817	do	do	56 52	134 21	N	VT	4,450	20	18.39	1,246	B	do	do	
818	do	Meade Point	56 54	134 20	0.1 Al, .9 N	M	8,450	150	261.88	80,290	A	do	do	
819	do	Saginaw Bay	56 54	134 16	0.2 Al, .8 N	MH	4,900	20	20.25	9,575	B	Saginaw Bay	Saginaw Bay	
820	do	Halleck Harbor	56 54	134 14	N	M	2,100	5	2.17	286	B	do	do	
821	do	Cornwallis Point	56 56	134 16	0.9 Al, .1N	MH	1,430	10	2.95	202	B	do	do	
822	do	do	56 56	134 13	Al	H	8,050	20	33.26	991	B	do	do	
823	D & E.	Keku Islets	56 55	134 09	0.2 Al, .8 N	MH	4,250	20	17.56	6,715	B	Kake	Keku Islets	C
824	do	do	56 56	134 08	Al	VH	2,900	30	17.98	675	D	do	do	C
825	do	do	56 55	134 07	0.2 Al, .8 N	M	1,700	4	1.40	393	B	do	do	C
826	do	do	56 57	134 07	0.4 Al, .6 N	H	5,000	25	28.83	9,807	C	do	do	C
827	do	do	56 58	134 07	0.1 Al, .9 N	T	100	100	2.07	380	B	do	do	C
828	do	do	56 56	134 05	0.2 Al, .8 N	M	2,650	15	8.21	2,253	C	do	do	C
829	do	do	56 55	134 03	0.6 Al, .4 N	T	4,000	30	24.79	2,164	C	do	do	C
830	do	do	56 54	134 ..	N	VT	600	50	6.20	420	D	do	do	C
831	do	do	56 54	134 03	N	VT	725	20	3.00	119	A	do	do	C

832	...do...	.....do	56	54	134	05	0.1 Al, .9 N	VT	2,275	30	14.10	850	A	.....do	.....do	C
833	...do...	Keku Inlet	56	51	134	..	0.1 Al, .9 N	VT	2,300	200	95.04	1,457	B	.....do	Trap Cove	C
834	...do...	.....do	56	51	133	57	0.4 Al, .6 N	M	400	65	5.37	744	C	.....do	.....do	C
835	...do...	Keku Islets	56	57	134	03	N	VT	2,700	100	55.78	940	A	.....do	Keku Islets	C
836	...do...	.....do	56	55	134	..	N	VT	4,675	100	96.59	2,415	A	.....do	Kake	C
837	...do...	.....do	56	54	133	59	N	VT	2,200	10	4.55	305	A	.....do	.....do	C
838	E.....	Keku Inlet	56	54	133	57	N	VT	300	300	18.60	630	A	.....do	.....do	C
839	...do...	.....do	56	54	133	56	N	VT	1,000	200	41.10	933	A	.....do	.....do	C
840	...do...	Hound Island	56	53	133	56	0.1 Al, .9 N	VT	6,000	50	61.98	2,360	A	.....do	.....do	C
841	...do...	.....do	56	53	133	55	N	VT	1,000	250	51.65	1,267	A	.....do	.....do	C
842	...do...	Pup Island	56	49	133	53	0.3 Al, .7 N	VT	700	20	2.89	140	B	.....do	Trap Cove	C
843	...do...	Keku Strait	56	48	133	50	0.9 Al, .1 N	VT	1,775	40	14.67	143	C	.....do	Keku Strait	C
844	...do...	.....do	56	47	133	48	0.8 Al, .2 N	M	500	14	1.45	117	C	.....do	Sheltered	C
845	...do...	Keku Inlet	56	50	133	49	Al	T	1,300	5	1.34	13	D	.....do	.....do	C
846	...do...	.....do	56	51	133	51	0.8 Al, .2 N	T	1,750	14	5.06	250	B	.....do	.....do	C
847	...do...	.....do	56	52	133	52	0.2 Al, .8 N	T	500	40	4.13	199	B	.....do	.....do	C
848	...do...	Point Hamilton	56	53	133	53	N	M	150	75	2.32	787	A	.....do	Hamilton Bay	C
849	...do...	.....do	56	54	133	53	0.6 Al, 4 N	M	2,200	10	4.55	662	B	.....do	.....do	C
850	...do...	Eva Island	56	55	133	54	0.5 Al, .5 N	M	1,550	20	6.40	1,138	B	.....do	.....do	C
851	...do...	Hamilton Bay	56	55	133	53	N	M	600	10	1.24	420	A	.....do	.....do	C
852	...do...	Kake	56	57	133	53	0.4 Al, .6 N	M	6,150	4	5.08	1,067	C	.....do	Kake	C
853	...do...	.....do	56	57	133	54	N	M	400	30	2.48	494	A	.....do	.....do	C
854	...do...	.....do	56	56	133	56	0.4 Al, .6 N	VT	1,500	100	30.99	1,302	B	.....do	.....do	C
855	...do...	.....do	56	58	133	56	0.2 Al, .8 N	VT	1,400	200	57.85	3,175	A	.....do	.....do	C
856	D & E.	.....do	56	58	133	58	N	VT	2,660	200	109.91	7,448	C	.....do	.....do	C
857	...do...	Point White	56	59	134	01	N	T	350	50	3.61	735	A	.....do	.....do	C
858	...do...	Kake	56	59	133	58	N	VT	2,400	20	9.92	672	A	.....do	.....do	C
859	...do...	Point White	56	59	133	59	N	VT	850	155	27.22	1,874	A	.....do	.....do	C
860	...do...	.....do	57	00	134	00	N	VT	1,760	10	3.63	256	B	.....do	.....do	C
861	...do...	Point Macartney	57	01	134	01	N	M	565	30	3.50	1,050	A	.....do	.....do	C
862	...do...	Cape Bendel	57	05	133	58	0.5 Al, .5 N	T	18,000	40	148.76	15,558	B	.....do	.....do	C
863	...do...	Pinta Rocks	57	05	133	59	N	VT	1,500	600	185.95	6,244	A	.....do	.....do	C
864	...do...	Turnabout Island	57	08	133	58	0.5 Al, .5 N	M	1,065	3	.66	124	C	.....do	.....do	C
865	E.....	.....do	57	05	133	50	0.9 Al, .1 N	M	6,755	20	27.89	1,362	B	.....do	.....do	C

TABLE XXXII.—*Location, area, and tonnage of the surveyed kelp beds of southeast Alaska*—Continued.

Bed No.	Sheet.	Vicinity.	Latitude.		Longitude.		Kind.	Density.	Length.	Width.	Area.	Estimated tonnage.	Availability.	Nearest deep harbor.	Nearest shelter.	Fish industry at harbor.
			°	′	°	′			*Yards.*	*Yards.*	*Acres.*	*Tons.*				
866	E	Turnabout Island	57	05	133	46	0.8 Al, .2 N	M	2,200	50	22.72	1,925	B	Kake	Kake	C
867	do	Portage Bay	57	03	133	32	0.6 Al, .4 N	M	20,840	105	452.10	65,557	B	Portage Bay	Portage Bay	
868	do	do	57	01	133	25	Al	T	1,100	2	.45	14	C	do	do	
869	do	West Point	57	01	133	22	0.5 Al, .5 N	T	3,750	30	23.22	2,467	B	do	do	
870	do	East Point	57	00	133	19	Al	M	1,200	4	.99	16	C	do	do	
871	do	Boulder Point	57	01	133	17	0.3 Al, .7 N	VT	200	150	6.20	60	A	do	do	
872	do	Portage Bay	57	01	133	13	N	T	200	15	.62	126	C	do	do	
873	do	Cape Strait	57	00	133	06	N	VT	300	10	.62	42	C	Thomas Bay	Thomas Bay	
874	do	do	56	59	133	04	N	T	1,200	3	.74	151	C	do	do	
875	do	do	56	58	133	02	0.3 Al, .7 N	T	660	3	.40	59	B	do	do	
876	do	do	56	56	132	59	N	T	500	10	1.03	210	C	Petersburg	Petersburg	CS
877	do	Petersburg	56	52	132	56	N	M	660	5	.68	231	C	do	do	CS
878	do	do	56	51	132	56	N	VT	2,900	60	35.95	1,218	B	do	do	CS
879	do	do	56	49	132	55	N	VT	2,450	75	37.97	130	A	do	do	CS
880	do	Frederick Point	56	48	132	48	N	VT	800	80	13.22	880	B	do	do	CS
881	do	Wrangell Strait	56	37	132	57	0.5 Al, .5 N	M	1,800	3	1.12	197	D	Duncan Canal	Beecher Pass	
882	do	do	56	36	132	57	N	T	9,000	3	5.58	1,134	C	do	do	
883	do	Sukoi Islets	56	54	132	55	N	VT	4,500	10	9.30	630	B	Petersburg	Petersburg	CS
884	do	Wood Point	56	59	132	56	N	VT	250	15	.77	60	A	Thomas Bay	Thomas Bay	
885	do	Point Vandeput	57	01	133	00	0.1 Al, .9 N	T	2,500	15	7.75	1,413	A	do	do	
886	do	Grand Point	57	05	133	08	N	M	8,200	5	8.45	2,870	C	Farragut Bay	Farragut Bay	
887	do	Read Island	57	07	133	12	N	M	4,700	20	19.42	6,580	B	do	do	
888	do	Farragut Bay	57	07	133	14	N	VT	300	50	3.10	208	A	do	do	
889	do	Bay Point	57	07	133	20	0.2 Al, .8 N	T	13,575	10	28.05	4,000	B	do	do	
890	do	Point Highland	57	08	133	27	.7 Al, .3 N	VT	2,000	5	2.07	47	B	Fanshaw Bay	Fanshaw Bay	S
891	do	Cape Fanshaw	57	10	133	31	.4 Al, .6 N	M	6,900	20	28.51	5,775	B	do	do	S
892	do	Storm Island	57	12	133	34	.6 Al, .4 N	M	3,500	5	3.62	521	C	do	do	S
893	do	Whitney Island	57	14	133	32	.8 Al, .2 N	M	6,900	10	14.26	1,154	B	do	do	S
894	do	Cleveland Passage	57	14	133	30	.5 Al, .5 N	T	7,300	15	22.63	2,411		do	Sheltered	S

895	...do...	The Five Fingers	57	17	133	39	Al	VH	2,000	10	4.13	150	C	.....do	Steamboat Bay	S
896	...do...	Sail Island	57	20	133	42	Al	H	400	10	.83	25	....	Port Houghton.	The Brothers	....
897	...do...	Fort Point	57	16	133	30	0.6 Al, .4 N	MH	8,400	30	52.07	10,605	B	Fanshaw Bay	Steamboat Bay	S
898	...do...	Robert Islands	57	18	133	29	Al	H	2,400	5	2.48	90	D	.....do	Robert Islands	S
899	...do...	Point Walpole	57	18	133	31	0.7 Al, .3 N	M	1,500	25	7.75	876	B	.....do	.....do	S
900	...do...	Robert Islands	57	18	133	29	0.9 Al, .1 N	MH	2,200	40	18.19	1,243	C	.....do	.....do	S
901	...do...	Point Hobart	57	22	133	28	N	H	2,000	40	16.53	10,080	B	Hobart Bay	Hobart Bay	....
902	...do...	Hobart Bay	57	24	133	27	0.3 Al, .7 N	T	500	50	5.17	260	....	.....do	.....do	....
903	...do...	Entrance Island	57	25	133	26	0.3 Al, .7 N	M	1,700	5	1.75	425	C	.....do	.....do	....
904	...do...	Hobart Bay	57	25	133	26	0.3 Al, .7 N	VT	800	40	6.61	330	B	.....do	.....do	....
905	...do...	.....do	57	27	133	29	N	VT	6,600	20	27.27	1,848	....	.....do	.....do	....
906	...do...	Sunset Island	57	28	133	31	N	M	2,700	15	8.37	2,835	....	.....do	.....do	....
907	...do...	.....do	57	30	133	34	0.3 Al, .7 N	M	3,300	5	3.40	821	....	Windham Bay.	Windham Bay	....
908	...do...	.....do	57	31	133	31	N	VT	5,590	30	34.66	1,249	....	.....do	.....do	....
909	...do...	Point Windham	57	34	133	33	N	VT	3,100	8	5.12	332	....	.....do	.....do	....
910	...do...	Point League	57	37	133	39	N	VT	3,100	5	3.20	217	....	.....do	Mouth Cove	....
911	...do...	Point Lookout	57	39	133	40	N	VT	4,500	3	2.79	189	....	Holkham Bay	.....do	....
912	...do...	Point Astley	57	42	133	38	0.5 Al, .5 N	VT	2,900	5	3.00	78	....	.....do	Holkham Bay	....
913	...do...	Wood Spit	57	44	133	34	0.4 Al, .6 N	VT	300	10	.63	13	B	.....do	.....do	....
914	...do...	Round Islets	57	45	133	35	0.4 Al, .6 N	M	660	10	1.36	286	C	.....do	.....do	....
915	...do...	Harbor Island	57	46	133	38	Al	T	350	10	.72	8	C	.....do	.....do	....
916	C.....	Point Coke	57	49	133	44	Al	T	2,200	2	.90	9	D	.....do	.....do	....
917	...do...	Point Anmer	57	55	133	48	0.5 Al, .5 N	T	13,800	2	5.70	576	D	Port Snettisham	Snettisham	....
918	...do...	Point Styleman	57	59	133	54	0.3 Al, .7 N	VT	2,450	2	1.01	49	D	.....do	Mist Island	....
919	...do...	Limestone Inlet	58	01	133	57	0.2 Al, .8 N	T	6,050	1	1.25	206	D	Taku Harbor ..	Limestone Inlet	C
920	...do...	Stockade Point	58	03	134	00	0.1 Al, .9 N	T	4,450	1	.92	171	D	.....do	Taku Harbor	C
921	...do...	Grave Point	58	04	134	02	0.1 Al, .9 N	M	1,400	2	.58	167	D	.....do	.....do	C
922	...do...	Slocum Inlet	58	09	134	04	0.3 Al, .7 N	VT	1,300	2	.54	26	C	.....do	.....do	C
923	...do...	.....do	58	11	134	04	N	VT	1,500	2	.62	42	C	.....do	Slocum Inlet	C
924	...do...	Point Arden	58	09	134	10	N	VT	1,750	2	.72	49	C	.....do	.....do	C
925	...do...	Cove Point	58	08	134	09	N	VT	2,200	10	4.55	308	B	.....do	.....do	C
926	...do...	Grand Island	58	04	134	09	N	VT	2,200	5	2.27	154	C	.....do	Taku Harbor	C
927	...do...	Station Point	58	02	134	05	N	T	9,300	4	7.69	1,561	C	.....do	Station Point	C
928	...do...	South Island	57	58	134	03	N	VT	3,100	7	4.48	304	C	.....do	.....do	C
929	...do...	.....do	57	57	134	03	N	VT	400	50	4.13	140	B	.....do	.....do	C
930	...do...	Twin Point	57	57	134	02	N	VT	2,000	10	4.13	140	C	Snettisham	.....do	C

TABLE XXXII.—*Location, area, and tonnage of the surveyed kelp beds of southeast Alaska*—Continued.

Bed No.	Sheet.	Vicinity.	Latitude.	Longitude.	Kind.	Density.	Length.	Width.	Area.	Estimated tonnage.	Availability.	Nearest deep harbor.	Nearest shelter.	Fish industry at harbor.
			° ′	° ′			*Yards.*	*Yards.*	*Acres.*	*Tons.*				
931	C	Twin Point	57 56	134 00	N	VT	1,200	2	.50	34	D	Snettisham	Snettisham	
932	do	do	57 55	133 58	N	MH	1,100	10	2.27	1,078	D	do	do	
933	do	do	57 54	133 58	N	M	1,550	30	9.60	4,255	C	do	do	
934	do	do	57 52	133 58	N	VT	2,700	3	1.47	113	C	do	do	
935	do	do	57 51	133 56	N	VT	800	2	.33	22	D	Holkham Bay	do	
936	do	Point Glass	57 50	133 54	N	T	1,750	3	1.08	222	C	do	do	
937	do	do	57 49	133 54	0.1 Al, .9 N	T	1,300	3	.80	148	C	do	do	
938	E	do	57 48	133 53	0.5 Al, .5 N	M	1,600	20	6.61	1,175	B	do	do	
939	do	Midway Point	57 45	133 53	0.1 Al, .9 N	T	4,450	15	13.79	2,537	C	do	Midway Point	
940	do	do	57 43	133 52	N	T	1,750	15	5.42	367	C	do	do	
941	do	do	57 42	133 52	0.8 Al, .2 N	VT	300	100	6.30	101	A	do	do	
942	do	do	57 41	133 52	0.1 Al, .9 N	T	1,000	18	3.72	701	A	do	do	
943	do	do	57 40	133 52	N	VT	600	20	2.49	68	A	do	do	
944	do	Point Hugh	57 39	133 50	N	VT	4,650	10	9.60	325	B	do	Mouth Cove	
945	do	do	57 36	133 48	0.7 Al, .3 N	VT	4,000	10	8.26	188	A	Mole Harbor	do	
946	do	do	57 34	133 48	N	VT	400	50	4.13	140	A	do	do	
947	do	Seymour Canal	57 32	133 55	N	VT	4,900	10	10.12	686	B	Gambier Bay	Gambier Bay	C
948	do	Point Gambier	57 28	133 51	N	T	1,800	30	11.16	1,148	B	do	do	C
949	do	Romp Island	57 27	133 51	N	M	650	20	2.68	910	C	do	do	C
950	do	Gambier Island	57 26	133 50	N	M	4,250	20	17.56	5,950	B	do	do	C
951	do	Gambier Bay	57 28	133 54	N	VT	3,000	30	18.60	1,260	B	do	do	C
952	do	do	57 28	133 57	N	VT	1,000	10	2.07	70	B	do	do	C
953	do	do	57 27	133 54	0.1 Al, .9 N	VT	300	25	1.55	97	A	do	do	C
954	do	do	57 26	133 53	N	VT	400	25	2.07	140	C	do	do	C
955	do	Price Island	57 25	133 52	N	VT	1,400	15	4.34	294	C	do	do	C
956	do	do	57 24	133 53	N	VT	300	15	.93	63	C	do	do	C
957	do	False Point Pybus	57 23	133 51	0.6 Al, .4 N	VT	2,350	4	1.94	58	C	do	do	C
958	do	do	57 21	133 51	0.9 Al, .1 N	M	2,450	10	5.06	247	C	do	do	C
959	D	Point Pybus	57 20	133 55	0.9 Al, .1 N	T	6,450	25	33.32	975	B	Pybus Bay	Pybus Bay	
960	E	do	57 19	133 56	0.7 Al, .3 N	MH	400	20	1.65	263	C	do	do	

961	...do...	The Brothers	57	18	133	51	Al	H	3,550	15	11.00	322	C	.....do	The Brothers	....
962	...do...	.....do	57	18	133	48	0.9 Al .1 N	M	6,450	10	13.32	2,452	C	.....do	.....do	....
963	...do...	.....do	57	18	133	47	Al	MH	2,250	4	1.86	31	C	.....do	.....do	....
964	...do...	.....do	57	17	133	48	0.6 Al .4 N	H	200	100	4.13	1,081	B	.....do	.....do	....
965	...do...	.....do	57	18	133	50	Al	M	1,100	5	1.36	19	C	.....do	.....do	....
966	...do...	.....do	57	17	133	50	Al	MH	4,000	20	16.53	384	B	.....do	.....do	....
967	...do...	.....do	57	16	133	52	Al	MH	1,200	15	3.72	86	C	.....do	.....do	....
968	...do...	.....do	57	17	133	02	Al	H	1,800	15	5.58	162	C	.....do	.....do	....
969	D & E.	Point Pybus	57	18	133	57	0.2 Al .8 N	VT	4,200	20	17.36	974	B	.....do	Pybus Bay	....
970	...do...	Pybus Bay	57	19	134	00	N	VT	600	15	1.86	63	B	.....do	.....do	....
971	...do...	.....do	57	18	134	00	0.2 Al .8 N	VT	2,500	31	16.01	449	B	.....do	.....do	....
972	...do...	.....do	57	17	134	00	0.8 Al .2 N	T	4,000	150	123.96	5,971	B	.....do	.....do	....
973	...do...	.....do	57	19	134	04	0.1 Al .9 N	VT	880	10	1.82	56	B	.....do	.....do	....
974	...do...	.....do	57	19	134	06	0.6 Al .4 N	VT	1,500	9	2.79	38	B	.....do	.....do	....
975	...do...	.....do	57	18	134	04	N	VT	1,750	50	18.08	1,225	B	.....do	.....do	....
976	...do...	.....do	57	16	134	03	0.7 Al .3 N	T	6,730	25	34.76	2,718	B	.....do	.....do	....
977	...do...	.....do	57	15	134	02	0.9 Al .1 N	M	1,750	100	36.16	6,965	B	.....do	.....do	....
978	...do...	.....do	57	16	134	05	N	VT	1,800	17	6.32	235	B	.....do	.....do	....
979	...do...	.....do	57	14	134	06	N	VT	1,000	140	28.93	1,120	B	.....do	.....do	....
980	...do...	.....do	57	14	134	07	N	VT	1,300	15	4.03	273	C	.....do	.....do	....
981	...do...	.....do	57	13	134	07	N	VT	1,000	100	20.66	1,400	A	.....do	.....do	....
982	...do...	Spruce Island	57	13	134	05	0.8 Al .2 N	T	3,100	5	3.20	650	B	.....do	.....do	....
983	...do...	Deepwater Point	57	12	134	10	0.7 Al .3 N	T	12,120	30	75.13	4,995	B	Woewoodsky Harbor.	Woewoodsky Harbor.	....
984	D.....	Liesnoi Island	57	11	134	15	0.2 Al .8 N	VT	7,750	27	42.23	727	B	.....do	.....do	....
985	...do...	Point Napean	57	08	134	17	0.5 Al .5 N	M	6,200	20	25.62	4,547	B	Eliza Harbor	Eliza Harbor	....
986	...do...	Herring Bay	57	07	134	20	N	VT	7,000	110	159.09	16,590	B	Herring Bay	Herring Bay	....
987	...do...	.....do	57	07	134	23	N	VT	2,210	200	91.32	2,690	B	.....do	.....do	....
988	...do...	.....do	57	06	134	21	0.4 Al .6 N	M	300	150	9.30	1,900	A	.....do	.....do	....
989	...do...	Point Brightman	57	04	134	24	0.4 Al .6 N	M	7,000	15	21.69	4,540	B	.....do	.....do	....
990	...do...	Carroll Island	57	02	134	30	0.2 Al .8 N	MH	12,000	130	322.31	152,460	B	Murder Cove	Carroll Island	....
991	...do...	Yasha Island	56	58	134	34	0.8 Al .2 N	M	1,600	25	8.26	660	C	.....do	Murder Cove	....
992	...do...	Surprise Harbor	57	01	134	35	0.2 Al .8 N	VT	5,000	160	165.29	17,616	B	Surprise Harbor	Surprise Harbor	....
993	...do...	Point Gardner	57	03	134	37	0.1 Al .9 N	MH	13,300	45	123.65	53,257	B	.....do	.....do	....

TABLE XXXII.—*Location, area, and tonnage of the surveyed kelp beds of southeast Alaska*—Continued.

Bed No.	Sheet.	Vicinity.	Latitude.		Longitude.		Kind.	Density.	Length.	Width.	Area.	Estimated tonnage.	Availability.	Nearest deep harbor.	Nearest shelter.	Fish industry at harbor.
			°	′	°	′			Yards.	Yards.	Acres.	Tons.				
994	D	Point Wilson	57	06	134	37	0.6 Al, .4 N	M	5,800	65	77.89	11,305	B	Surprise Harbor	Wilson Cove	
995	do	Wilson Cove	57	09	134	37	0.1 Al, .9 N	VT	3,500	30	21.69	1,315	B	Whitewater Bay.	do	
996	do	do	57	09	134	38	N	T	100	20	.41	83	C	do	do	
997	do	do	57	12	134	38	0.1 Al, .9 N	T	8,000	65	107.44	19,145	B	do	do	
998	do	Point Caution	57	15	134	39	0.6 Al, .4 N	M	3,550	175	128.36	18,625	B	do	Whitewater Bay	
999	do	do	57	14	134	37	N	VT	2,900	20	11.98	799	B	do	do	
1000	do	Whitewater Bay	57	13	134	35	N	VT	300	50	3.10	210	C	do	do	
1001	do	Sand Point	57	14	134	34	N	VT	400	10	.84	56	B	do	do	
1002	do	Healy Rock	57	14	134	36	N	T	200	10	.41	83	C	do	do	
1003	do	Woody Point	57	17	134	34	0.2 Al, .8 N	T	13,300	65	178.61	29,386	A	do	do	
1004	do	do	57	17	134	37	N	T	150	75	2.32	471	A	do	do	
1005	do	Chaik Bay	57	19	134	35	0.8 Al, .2 N	M	800	300	49.58	4,023	A	Chaik Bay	Chaik Bay	
1006	do	do	57	20	134	31	N	VT	525	35	3.80	254	A	do	do	
1007	do	do	57	20	134	24	N	VT	300	70	4.36	88	A	do	do	
1008	do	Distant Point	57	22	134	24	N	VT	14,200	46	134.95	8,857	B	Hood Bay	Hood Bay	
1009	do	Hood Bay	57	22	134	28	N	VT	4,000	20	16.53	1,120	B	do	Sheltered	
1010	do	do	57	23	134	28	N	VT	2,000	30	12.40	840	B	do	do	
1011	do	do	57	24	134	29	N	VT	1,500	57	17.60	637	A	do	Hood Bay	
1012	do	Killisnoo	57	26	134	31	N	VT	6,250	15	19.37	1,312	C	Killisnoo	Killisnoo	F
1013	do	Hood Bay	57	25	134	32	N	VT	600	100	12.40	840	A	do	Hood Bay	F
1014	do	Sand Island	57	26	134	33	N	T	2,050	135	57.18	11,132	B	do	Killisnoo	F
1015	do	Table Island	57	27	134	35	0.2 Al, .8 N	M	3,500	100	72.31	19,815	B	do	do	F
1016	do	Killisnoo	57	28	134	33	N	M	500	150	15.50	6,000	A	do	Sheltered	F
1017	do	do	57	28	134	33	N	VT	880	100	18.18	1,293	A	do	do	F
1018	do	Killisnoo Island	57	28	134	35	0.2 Al, .8 N	MH	7,750	12	19.22	7,420	B	do	Killisnoo	F
1019	do	Kenasnow Rock	57	29	134	35	0.9 Al, .1 N	MH	800	35	5.79	399	B	do	do	F
1020	do	Angoon	57	30	134	35	0.3 Al, .7 N	MH	6,650	20	27.48	9,238	B	do	do	F
1021	do	Kootznahoo Inlet	57	30	134	35	0.4 Al, .6 N	H	2,200	25	11.36	4,300	B	do	Sheltered	F
1022	do	do	57	29	134	34	0.2 Al, .8 N	H	1,100	5	1.14	546	C	do	do	F

1023	...do...	.....do	57	29	134	33	0.2 Al .8 N	T	2,000	60	24.79	4,080	B	.....do	.....do	F
1024	...do...	.....do	57	30	134	33	0.1 Al .9 N	MH	3,300	12	8.18	3,172	B	.....do	.....do	F
1025	...do...	.....do	57	31	134	32	0.7 Al .3 N	H	3,100	15	9.60	1,401	D	.....do	.....do	F
1026	...do...	.....do	57	31	134	32	0.8 Al .2 N	VH	880	5	.90	170	D	.....do	.....do	F
1027	...do...	.....do	57	30	134	34	0.7 Al .3 N	VH	3,250	9	5.84	1,282	C	.....do	.....do	F
1028	...do...	.....do	57	32	134	36	0.6 Al .4 N	H	9,100	16	30.08	5,750	B	.....do	Kootznahoo Inlet.	F
1029	...do...	Parker Point	57	36	134	39	0.8 Al .2 N	M	5,000	40	41.32	3,587	A	.....do	.....do	F
1030	...do...	Parker Bay	57	39	134	41	0.9 Al .1 N	M	7,200	30	44.62	2,231	B	Basket Bay	Basket Bay	....
1031	...do...	Marble Bluffs	57	42	134	42	0.6 Al .4 N	MH	4,900	15	15.18	3,042	B	.....do	.....do	....
1032	C & D.	Fishery Point	57	47	134	43	0.5 Al .5 N	T	3,750	10	7.75	810	B	Tenakee Inlet	Horse Cove	....
1033	...do...	.....do	57	50	134	43	0.4 Al .6 N	VT	5,550	15	17.20	748	B	Pavlof Harbor	.....do	....
1034	...do...	Horse Cove	57	53	134	44	0.3 Al .7 N	T	2,200	15	6.81	974	B	Gypsum	.....do	....
1035	...do...	Point Hepburn	57	55	134	45	0.1 Al .9 N	T	6,860	16	22.68	3,411	B	.....do	.....do	....
1036	...do...	Point Cube	57	58	134	45	N	H	5,100	33	34.77	21,349	B	.....do	Square Cove	....
1037	...do...	Point Marsden	58	01	134	47	N	H	10,700	13	28.74	17,646	B	Hawk Inlet	Game Cove	C
1038	C.	.....do	58	04	134	47	N	MH	1,100	20	4.55	2,167	B	.....do	.....do	C
1039	...do...	Hawk Inlet	58	05	134	46	N	T	1,300	14	3.76	512	B	.....do	Hawk Inlet	C
1040	...do...	.....do	58	05	134	45	N	T	1,750	15	5.44	1,102	B	.....do	.....do	C
1041	...do...	.....do	58	06	134	45	N	VT	1,300	140	37.60	1,320	B	.....do	.....do	C
1042	...do...	.....do	58	06	134	48	N	T	3,300	50	34.09	6,930	B	.....do	.....do	C
1043	...do...	.....do	58	07	134	49	N	M	50	50	.52	175	B	.....do	.....do	C
1044	...do...	Funter Bay	58	11	134	52	0.2 Al .8 N	M	14,650	10	30.27	8,305	B	Funter Bay	Funter Bay	C
1045	...do...	Station Island	58	14	134	53	N	VT	1,000	10	2.07	105	B	.....do	.....do	C
1046	...do...	The Kittens	58	15	134	55	N	VT	2,500	10	5.17	350	B	.....do	.....do	C
1047	...do...	Funter Bay	58	17	134	55	N	T	4,850	10	10.02	2,037	B	.....do	.....do	C
1048	...do...	Point Retreat	58	19	134	56	N	T	5,550	5	5.73	1,165	B	.....do	.....do	C
1049	...do...	.....do	58	23	134	57	N	T	6,200	25	32.02	6,510	B	.....do	.....do	C
1050	...do...	.....do	58	24	134	55	N	VT	2,200	5	2.27	77	A	Barlow Cove	Barlow Cove	....
1051	...do...	Barlow Cove	58	22	134	54	N	VT	2,900	5	3.00	21	B	.....do	.....do	....
1052	...do...	Hump Island	58	27	134	58	N	VT	2,200	15	6.82	231	B	.....do	.....do	....
1053	...do...	Lincoln Island	58	29	135	00	N	VT	2,200	5	2.27	77	B	Tee Harbor	Tee Harbor	C
1054	...do...	Ralston Island	58	32	135	02	N	VT	2,450	10	5.06	171	B	.....do	.....do	C
1055	...do...	Point Howard	58	23	135	04	N	T	2,650	30	16.43	3,339	B	Barlow Cove	Barlow Cove	....
1056	...do...	.....do	58	21	135	03	N	T	3,100	5	3.20	651	B	Funter Bay	.....do	C
1057	...do...	.....do	58	17	135	03	N	VT	800	70	11.57	392	B	.....do	Point Howard	C
1058	...do...	Point Couverden	58	14	135	03	N	VT	1,750	5	1.80	122	B	Swanson Harbor	Couverden Island	....
1059	...do...	.....do	58	13	135	02	N	M	100	20	.41	140	C	.....do	.....do	....
1060	...do...	Couverden Island	58	13	135	04	N	VT	4,500	5	4.65	315	B	.....do	.....do	....

TABLE XXXII.—*Location, area, and tonnage of the surveyed kelp beds of southeast Alaska*—Continued.

Bed No.	Sheet.	Vicinity.	Latitude.	Longitude.	Kind.	Density.	Length.	Width.	Area.	Estimated tonnage.	Availability.	Nearest deep harbor.	Nearest shelter.	Fish industry at harbor.
			° ′	° ′			*Yards.*	*Yards.*	*Acres.*	*Tons.*				
1061	C	Point Couverden	58 11	135 03	N	M	650	20	2.69	910	B	Swanson Harbor	Swanson Harbor	
1062	do	Couverden Island	58 11	135 04	N	M	1,350	10	2.79	945	B	do	do	
1063	do	Entrance Island	58 12	135 06	N	M	4,200	50	43.39	14,700	B	do	do	
1064	do	Swanson Harbor	58 12	135 08	N	M	1,750	75	27.12	9,157	B	do	do	
1065	do	do	58 12	135 06	N	VT	1,300	5	1.34	91	B	do	do	
1066	do	Chatice Bay	58 05	135 05	N	T	400	15	1.24	252	B	Chatice Bay	Chatice Bay	C
1067	C & D	Point Augusta	58 03	135 00	N	VT	2,000	5	2.07	140	C	do	do	
1068	do	do	58 02	134 55	N	T	6,450	10	13.33	2,709	C	do	do	
1069	do	False Bay	57 59	134 54	N	VT	4,650	5	4.80	428	C	Gypsum	False Bay	
1070	do	do	57 58	134 55	N	T	1,300	10	2.68	546	C	do	do	
1071	do	do	57 56	134 55	N	M	4,450	20	18.39	6,230	B	do	do	
1072	do	Iyoukeen Cove	57 54	134 57	N	T	150	20	.62	126	B	do	Gypsum	
1073	do	do	57 53	134 59	N	T	200	10	.41	84	B	do	do	
1074	do	North Passage Point	57 51	134 56	N	M	1,500	10	3.10	1,050	B	Pavlof Harbor	Wachusett Cove	
1075	do	East Point	57 48	134 56	N	T	400	20	1.65	366	B	do	do	
1076	do	South Passage Point	57 45	134 55	N	VT	900	5	.93	63	B	Tenakee Inlet	Tenakee Inlet	
1077	D	do	57 43	134 55	N	M	2,000	15	6.20	2,100	B	Basket Bay	Basket Bay	
1078	do	Basket Bay	57 41	134 54	N	T	1,600	40	13.22	2,688	B	do	do	
1079	do	do	57 40	134 54	N	T	2,500	25	12.91	2,625	B	do	do	
1080	do	do	57 39	134 53	N	M	4,200	12	10.41	3,528	B	do	do	
1081	do	do	57 36	134 51	N	M	10,650	10	22.00	7,455	B	do	do	
1082	do	White Rock	57 32	134 51	N	T	4,900	25	25.30	5,145	B	Chatham	Penin Cove	C
1083	do	Peninsular Point	57 30	134 49	{0.1 A .9 N}	M	2,650	15	8.21	2,514	C	do	do	C
1084	do	Morris Reef	57 28	134 49	N	VT	2,450	200	101.24	6,860	A	do	Sula Cove	C
1085	do	do	57 29	134 50	{0.1 Al .9 N}	M	6,900	35	49.90	15,297	C	do	do	C
1086	do	Sitkoh Bay	57 30	134 53	N	T	900	20	3.72	756	B	do	Sheltered	C
1087	do	Point Craven	57 28	134 52	{0.3 Al .7 N}	M	3,100	12	7.69	1,843	B	do	Sitkoh Bay	C
1088	do	Lindenberg Harbor	57 28	135 04	N	VT	100	50	1.03	70	B	Saook Bay	Lindenberg Harbor.	
1089	do	Eva Islands	57 26	134 56	N	T	500	100	10.33	2,100	B	Chatham	Traders Islands	C
1090	do	do	57 26	134 54	N	T	2,700	30	16.74	3,402	B	do	do	C
1091	do	Traders Islands	57 25	134 53	N	VT	1,600	25	8.26	560	B	do	do	C
1092	do	Fairway Island	57 27	134 52	N	VT	600	25	3.09	84	B	do	do	C
1093	do	Midway Reef	57 26	134 51	N	VT	1,100	50	11.36	770	A	do	do	C
1094	do	Traders Islands	57 26	134 53	N	VT	2,400	50	24.79	1,680	B	do	do	C
1095	do	Point Thatcher	57 25	134 50	N	VT	2,525	80	41.74	5,656	A	do	do	C
1096	do	do	57 23	134 49	N	VT	4,500	300	278.93	1,890	A	Kelp Bay	do	
1097	do	do	57 22	134 49	N	VT	150	50	1.55	52	A	do	Lull Cove	

1098	...do...	Point Lull	57	21	134	48	N	VT	2,400	25	12.40	840	A	....do	....do	....
1099	...do...	....do	57	19	134	48	N	M	300	100	6.20	2,100	A	....do	....do	....
1100	...do...	....do	57	19	134	49	N	VT	5,000	100	103.30	6,725	A	....do	....do	....
1101	...do...	North Point	57	18	134	50	0.1 Al, .9 N	T	3,100	25	16.01	2,945	B	....do	....do	....
1102	...do...	Kelp Bay	57	19	134	52	N	VT	3,550	25	18.34	1,232	B	....do	Kelp Bay	....
1103	...do...	....do	57	21	134	54	N	VT	2,900	7	4.40	284	B	....do	....do	....
1104	...do...	Portage Point	57	20	134	55	N	VT	4,450	15	13.79	934	B	....do	....do	....
1105	...do...	....do	57	19	134	55	N	T	200	20	.83	168	A	....do	....do	....
1106	...do...	Kelp Bay	57	19	134	56	N	VT	200	30	1.24	84	A	....do	....do	....
1107	...do...	Crow Islands	57	18	134	54	N	T	350	10	.72	147	A	....do	....do	....
1108	...do...	Pond Island	57	17	134	52	N	T	200	30	1.24	252	B	....do	....do	....
1109	...do...	....do	57	17	134	52	N	VT	900	10	1.86	126	B	....do	....do	....
1110	...do...	Cosmos Cove	57	15	134	51	N	M	4,400	7	6.36	2,156	B	Cosmos Cove	Cosmos Cove	....
1111	...do...	....do	57	14	134	50	N	M	3,100	25	16.01	5,425	A	....do	....do	....
1112	...do...	Kasnyku Bay	57	13	134	52	N	VT	200	10	.41	28	B	Takatz Bay	Kasnyku Bay	....
1113	...do...	....do	57	12	134	50	N	M	400	50	4.13	1,400	B	....do	....do	....
1114	...do...	....do	57	12	134	50	N	T	100	20	.41	84	C	....do	....do	....
1115	...do...	....do	57	11	134	49	N	VT	800	5	.83	56	C	....do	....do	....
1116	...do...	....do	57	11	134	49	0.5 Al, .5 N	T	400	5	.41	43	C	....do	....do	....
1117	...do...	Point Turbot	57	10	134	48	0.7 Al, .3 N	M	2,900	4	2.40	271	C	....do	Takatz Bay	....
1118	...do...	Takatz Bay	57	09	134	49	N	VT	100	20	.41	28	B	....do	....do	....
1119	...do...	....do	57	09	134	49	N	T	1,100	5	1.14	231	C	....do	....do	....
1120	...do...	Takatz Islands	57	07	134	48	0.7 Al, .3 N	MH	7,700	10	15.90	2,855	B	....do	....do	....
1121	...do...	Baranof	57	04	134	46	0.9 Al, .1 N	MH	2,000	5	2.07	141	B	Baranof	Warm Spring Bay	....
1122	...do...	....do	57	03	134	45	0.7 Al, .3 N	M	2,550	5	2.63	298	C	....do	....do	....
1123	...do...	Cascade Bay	57	02	134	45	Al	H	2,200	7	3.18	95	B	Cascade Bay	Cascade Bay	....
1124	...do...	....do	57	01	134	45	0.5 Al, .5 N	M	500	10	1.03	184	B	....do	....do	....
1125	...do...	....do	57	01	134	45	0.7 Al, .3 N	MH	400	15	1.24	191	B	....do	....do	....
1126	...do...	Alaria Bay	57	00	134	44	0.8 Al, .2 N	M	4,900	8	8.10	656	B	....do	Alaria Bay	....
1127	...do...	....do	56	58	134	44	Al	MH	2,650	4	2.19	53	C	Nelson Bay	....do	....
1128	...do...	Nelson Bay	56	56	134	43	0.8 Al, .2 N	M	5,300	10	10.95	888	B	....do	Nelson Bay	....
1129	...do...	....do	56	54	134	42	0.7 Al, .3 N	M	7,600	10	15.70	1,779	B	....do	....do	....
1130	...do...	Red Bluff Bay	56	51	134	42	0.8 Al, .2 N	T	1,100	5	1.13	86	C	Red Bluff Bay	Red Bluff Bay	....
1131	...do...	....do	56	50	134	42	0.7 Al, .3 N	T	880	15	2.73	305	C	....do	....do	....
1132	...do...	Hoggatt Bay	56	48	134	40	0.8 Al, .2 N	M	8,450	10	17.46	1,416	B	Hoggatt Bay	Hoggatt Bay	....
1133	...do...	....do	56	45	134	39	0.6 Al, .4 N	M	4,000	10	8.26	1,203	B	Gut Bay	Gut Bay	....

TABLE XXXII.—*Location, area, and tonnage of the surveyed kelp beds of southeast Alaska*—Continued.

Bed No.	Sheet.	Vicinity.	Latitude.		Longitude.		Kind.	Density.	Length.	Width.	Area.	Estimated tonnage.	Availability.	Nearest deep harbor.	Nearest shelter.	Fish industry at harbor.
			°	′	°	′			*Yards.*	*Yards.*	*Acres.*	*Tons.*				
1134	D	Hoggatt Bay	56	43	134	38	0.8 Al, .2 N	M	2,650	15	8.21	698	B	Gut Bay	Gut Bay	
1135	do	Deep Hole	56	41	134	38	0.4 Al, .6 N	T	6,200	20	25.62	3,224	B	do	Deep Hole	
1136	do	Point Patterson	56	38	134	38	0.3 Al, .7 N	T	5,400	5	5.79	810	C	do	Gut Bay	
1137	do	do	56	35	134	38	0.7 Al, .3 N	M	1,750	4	1.44	157	C	do	do	
1138	G	Foggy Point	54	56	130	58	N	VT	1,400	5	1.44	96	B	Foggy Bay	Foggy Bay	
1139	do	do	54	54	130	58	N	MH	5,200	45	48.35	20,770	B	do	do	
1140	do	do	54	52	130	58	N	T	6,500	23	30.89	6,118	C	do	do	
1141	do	Tree Point	54	49	130	57	N	T	2,900	10	5.99	1,218	D	do	Boat Harbor	
1142	do	Boat Harbor	54	48	130	56	N	VT	3,000	20	12.40	2,520	D	do	do	
1143	do	Cape Fox	54	46	130	53	N	M	5,300	25	27.37	9,275	C	Tongass Island	Scow Cove	
1144	do	do	54	46	130	50	N	T	800	40	6.61	1,344	B	do	do	
1145	do	Boat Rock	54	47	130	48	N	T	2,500	5	2.58	644	B	do	Tongass Island	
1146	do	Slim Island	54	48	130	47	N	T	400	5	.41	84	C	Nakat Harbor	Harry Bay	
1147	do	Harry Bay	54	48	130	46	N	T	1,900	25	9.81	1,995	C	do	do	
1148	do	Nakat Inlet	54	48	130	44	N	T	1,000	5	1.03	210	B	do	Nakat Inlet	
1149	do	Tongass Reef	54	47	130	45	N	T	300	30	1.86	378	C	Tongass Island	Tongass Island	
1150	do	Tongass Island	54	46	130	45	N	VT	3,300	70	47.73	3,234	B	do	do	
1151	do	Lord Islands	54	44	130	48	N	M	1,600	10	3.30	1,120	C	do	do	
1152	do	Kanagunut Island	54	44	130	43	N	T	8,500	10	17.52	3,570	C	do	do	
1153	do	Sitklan Island	54	45	130	40	N	T	14,450	3	8.96	1,810	C	do	do	
1154	do	Tongass Passage	54	46	130	42	N	VT	3,350	5	3.46	234	B	do	Sheltered	
1155	do	do	54	47	130	34	N	T	2,300	3	1.44	280	B	do	Wales Harbor	
1156	do	Pearse Inlet	54	47	130	38	N	VT	1,800	3	1.12	76	B	Fillmore Inlet	do	
1157	do	Fillmore Inlet	54	48	130	38	N	T	1,100	3	.68	139	B	do	do	
1158	do	do	54	49	130	38	N	M	3,800	5	3.92	1,330	B	do	Sheltered	
1159	do	do	54	47	130	37	N	VT	1,100	5	1.13	770	C	do	Wales Harbor	
1160	do	Pearse Inlet	54	48	130	35	N	T	350	20	1.44	294	B	do	do	
1161	do.[1]	Portland Canal	55	03	130	14	N	VT	6,200	5	6.39	434	B	Hidden Inlet	Pearse Inlet	C
1162	do.[1]	do	55	05	130	12	N	VT	3,100	5	3.20	217	B	do	do	C

[1] Northeast of.

V. THE KELP BEDS OF WESTERN ALASKA.

By George B. Rigg, *Expert in Kelp Investigations.*

INTRODUCTION.

The expedition sent out in 1913 to investigate the kelps of western Alaska as a source of potash fertilizer was a part of the general investigation of the fertilizer resources of the United States, conducted under the supervision of Dr. Frank K. Cameron in charge of the physical, chemical, and fertilizer investigations of the Bureau of Soils. This investigation was begun in 1911 and was continued in 1912 and 1913.

The personnel of the party was as follows: George B. Rigg, assistant professor of botany in the University of Washington (Seattle), scientist in kelp investigation, United States Department of Agriculture, in charge of the party; Robert F. Griggs, assistant professor of botany in Ohio State University, scientist in kelp investigation, United States Department of Agriculture; and Sanford M. Zeller, instructor in botany in the University of Washington (Seattle), field assistant in kelp investigation, United States Department of Agriculture.

The trip was made on the power schooner *Gjoa,* owned by King & Winge, of Seattle, with A. Mornes, captain. The boat is 56 feet long and is 12 feet 6 inches in beam. It has been regularly employed in halibut fishing in Alaskan waters. For this investigation an electric-light plant was installed, and a dark room for photography was partitioned off from the cabin.

We had on deck a 19-foot New England dory. Up to July 10 we were dependent upon oars as a means of propelling this dory. On that date we received at Seldovia a detachable gasoline engine for use in it.

LINES OF WORK.

The principal work of the expedition was (1) the preparation of maps showing the position of the kelp beds; (2) the preparation of tables giving the location, composition, and character of these beds, an estimate of the number of tons of kelp in each, and information as to available anchorages and shipping points; (3) the collection and drying of samples of kelps to be sent to the United States Bureau of Soils for chemical analysis; and (4) the making of photographs to show these beds and the nature of the plants composing

them. Opportunity was also found to collect information in regard to the use of kelp as fertilizer by citizens of Alaska and to secure photographs of crops being raised by the aid of kelp fertilizer. For mapping the kelp beds the expedition was provided with special photographic reproductions of the United States Coast and Geodetic Survey charts, made to a uniform scale of 1:200,000.

Preservatives and containers were provided by the University of Washington for putting up specimens in alcohol and in formalin, and some material was thus secured for morphological work. A few specimens of large kelps were also prepared by the glycerin method.[1] An herbarium of algæ of all groups was also prepared.

Measurements were made of the dimensions of large kelps and numerous specimens were weighed. A fairly complete daily record of the density and the temperature of the sea water was kept.

SCIENTIFIC EQUIPMENT.

The expedition was fitted out with cameras, balances, bottles, reagents, hydrometers, thermometers, drying apparatus, and all necessary equipment to make accurate observations upon the life history of the kelp and other flora. These data will be used for subsequent reports on the technical problems encountered and are not included here because they have only an indirect bearing on the utilization of the kelp as a source of potash salts.

The expedition was provided with a practically complete set of United States Coast and Geodetic Survey charts, both general charts and harbor charts. There is a good deal of unsurveyed coast in western Alaska. Shuyak Island and portions of Afognak Island and of the Alaska Peninsula are examples of this. In other cases the surveys are incomplete and portions of the shores are shown inaccurately and the soundings are unreliable. Port Wrangell, Mitrofania Bay, Port Hobron, and Cape Chiniak are examples of this.

ACKNOWLEDGMENTS.

It would be impossible to mention all who contributed to the success of the expedition by furnishing local information about harbors and anchorages, about the use of kelp as fertilizer, and by extending various other courtesies, but special acknowledgments are due to Capt. C. E. Ahues, of Yakutat; Messrs. Erskine and Fletcher, Capt. Charles Brown, Capt. A. Greene, Mr. J. J. Folstad, Dr. Joseph Silverman, Supt. M. D. Snodgrass (U. S. Experiment Station), and Mr. Blodgett (Kadiak Fisheries Co.), of Kodiak; Supt. George A. Learn, of the Baptist Orphanage on Woody Island; Capt. Quillian, of U. S. survey ship *McArthur;* Capt. Miller, of the U. S. survey ship

[1] See Plant World, 8, 202 (1911).

Patterson; Navigating Officer Thompson, of the U. S. revenue cutter *Manning;* and Capt. Crisp, of the U. S. revenue cutter *Unalga.*

WEATHER AND HARBOR CONDITIONS.

Good weather prevailed during the trip from Seattle to Cape Spencer. In the open water outside of this cape a heavy sea was running and we were forced to put into Dixon Harbor, a few miles north of the cape. After lying there two nights we found suitable weather to proceed to Yakutat, where we arrived in a gale and were forced to wait six days for suitable weather to proceed to Cape Hinchinbrook. The run from Yakutat to Port Etches, just inside Cape Hinchinbrook, was made on a smooth sea in fine weather, in 30 hours. Good weather prevailed during the run from Port Etches to Cordova and from there to Naked Island. During the following four days the weather was very rainy and windy, and as we were finding but little kelp in the region, we proceeded to Seward. Good weather prevailed during the trip from Seward to Seldovia, the only difficulty encountered being the heavy tide rips in the vicinity of Cape Elizabeth.

We had comparatively good weather during the time that we worked in Cook Inlet, although one dense fog came on suddenly when we were out in the dory, and on two afternoons strong breezes caused too much sea to admit of satisfactory work on the kelp beds.

The night spent at anchor at Augustine Island was the first night we did not have a good harbor. There is really no harbor there—only anchorage for certain kinds of wind, and the rocks are so numerous as to make it advisable to approach only at low water. The following night we anchored in a very open bight at Cape Douglas, and the boat rolled a good deal all night.

When we crossed Shelikof Strait the first time (June 11) it was perfectly smooth, but our later experience there in a gale on July 15 indicated that its reputation of being a treacherous body of water is not undeserved.

We had a good deal of fine weather during the 19 days that we worked around Kodiak Island and the neighboring islands, although we were hindered from work some whole days and parts of several other days by fogs and by on-shore winds. Strong tide rips were encountered in the vicinity of Dangerous Cape on the southern coast of Kodiak Island and in Geese Islands Straits near the southwest corner of the same island. The tide at the latter place would be a serious consideration in harvesting kelp from the large beds there, but fortunately Lazy Bay, which is not far distant, is a secure harbor in all kinds of wind. Olga Bay, on which the cannery is located, is said to be a good harbor when a boat is once inside, but the entrance is so narrow and rocky that it should not be attempted without local knowledge.

There is no good harbor on Kodiak Island from Lazy Bay to Uyak Bay, Halibut Bay north of Cape Ikolik being an anchorage for only certain kinds of wind. Behind the spit on Larsens Bay, an indentation of Uyak Bay, there is an excellent harbor furnishing secure anchorage for large vessels. The cannery at Larsens Bay was moved there a few years ago from Karluk because anchorage in the open roadstead at the latter place proved to be hazardous.

At the time of our visit all of Afognak and Shuyak Islands and the portion of Kodiak Island lying east of a line extending from Uyak Bay to Ugak Bay was completely covered with a layer (10 inches deep at Kodiak village) of volcanic ash from the eruption of Mount Katmai the previous year, and when the wind blew the air was filled with a cloud of dust that shut out from sight all objects except those close at hand and proved very irritating to the eyes. That these clouds were local was indicated by the fact that for awhile one afternoon when passing along the north side of Kodiak Island we could see the mountains on the north side of Shelikof Strait at a distance of 30 miles clearly, while we could not see the hills of Kodiak Island at a distance of 500 feet.

On our second trip around the end of Kenai Peninsula we went inside of Elizabeth Island and did not encounter as bad tide rips as we did on our previous trip outside of the island. Port Chatham is well surveyed and is a good harbor in all winds.

During our second trip to Seldovia the large kelp bed at Anchor Point was visited again for the purpose of making further observations and collecting more specimens. After a supply of distillate and gasoline had been taken on board and the engine had been fitted to the dory, we started westward to the Shumagin Islands.

From the day we left Seldovia (July 15) until August 4, when we left Sand Point for Seattle, there was only one day on which the sea was calm and only five others on which it was possible to run at all. Fogs, gales, and rain prevailed. The gale encountered in Shelikof Strait on July 15 was by far the roughest experience of the whole trip.

The usefulness of many of the harbors of western Alaska is seriously interfered with by williwaws. These are local winds of great force. They usually blow over harbors that are adjacent to rather steep mountains. Harbors bordered for some distance by rather low land seem to be free from them. In Three Saints Bay, on Kodiak Island, a williwaw of such force was encountered as to make anchorage impossible near the head of the bay. It was found, however, that Browns Lagoon, near the mouth of the bay, is a secure harbor, furnishing protection from wind in any direction, and is deep enough for the anchorage of vessels of considerable size.

HOW THE BEDS WERE MAPPED.

Where there was reasonably complete information about the waters and there was therefore reasonable assurance that they were fairly free from rocks, and the weather was favorable, we could run close enough to the beds with the schooner to determine the necessary data. Where this was not possible, the work had to be done from the dory.

TIME OF MATURITY OF KELPS.

Kelps mature somewhat later in the season in Alaska than they do in the Puget Sound region. Puget Sound kelps usually show plainly by June 1, while the Nereocystis bed at Seldovia, Alaska, could not be seen at the time of either our June or our July visit to that place, but was plainly visible in August. On July 5 a bed of young Nereocystis plants in Kodiak harbor was found at low tide which was not evident before that time. Alaria matures somewhat earlier than Nereocystis in Alaska.

DRIFT KELP.

Kelps are torn loose from their anchorage by the waves at all seasons of the year, but especially in fall and winter. Considerable quantities of the kelp thus torn loose drift upon exposed beaches. This was seen by the writer at Three Saints Bay, on Kodiak Island, even in the summer. Residents report that drifts several feet deep accumulate in fall and winter on the beaches of Middleton Island, Chirikof Island, Ban Island, and other places. While the drift kelp is sometimes used for direct application to near-by lands, it will be more advantageous where commercial fertilizers are to be prepared to harvest the growing kelp from the beds.

HARVESTING.

In harvesting these beds a sufficient portion of the kelp should be left uncut in each bed to insure the maturing of enough spores to produce the next year's crop. If a liberal amount is left for this purpose, it does not seem necessary to limit the season of cutting. That Alaria is very difficult to kill out is evident from the fact that for 17 years the cannery employees at Karluk River have been pulling out all of the kelp they could each year, in an effort to free the fishing grounds permanently from it, and have not yet entirely succeeded.

AVAILABILITY.

The kelp beds tabulated in this report differ greatly in their accessibility. Their accessibility depends upon the tidal currents, available anchorages, and shipping points, the completeness and

accuracy of the surveys of the region, the freedom of the region from rocks and other dangers to navigation and the weather conditions that prevail in the region. It should be borne in mind that some of the anchorages mentioned in the table are not safe shelters from all kinds of wind, being protected only from winds of certain direction.

A good deal of information about the availability of the beds may be obtained by referring to the kelp maps at the close of this report and then consulting "Alaska Coast Pilot Notes from Yakutat Bay to Cook Inlet and Shelikof Strait," second edition. This is a free publication of the United States Coast and Geodetic Survey. Anyone considering the commercial utilization of Alaska kelps should also provide himself with all of the Coast and Geodetic Survey charts that have been issued for the region that he is considering. It should be borne in mind that these charts are not always based on surveys, many of the bays being only sketches in which the positions of the shores are shown more or less inaccurately. The soundings are not always reliable. It was found best in making the surveys of the kelp beds of western Alaska to depend largely upon the advice of masters of vessels and other local authorities.

MIXED BEDS.

When Nereocystis and Alaria grow in the same bed, the Nereocystis usually forms the border of the bed, growing in a little deeper water and enduring heavier swells than the Alaria. This is notably the case in the beds around the Geese Islands and Aiaktalik Island near the southwest corner of Kodiak Island. Sometimes, however, the two are mixed throughout the bed. This occurs in the beds at Port Dick, at Hesketh Island in Cook Inlet, and near Whale Island, and Hog Island between Kodiak Island and Afognak Island. When the two occur together throughout the bed, Nereocystis does not reach such good development as it does where it forms a border to the Alaria.

SUPPLY AND VALUE OF KELP IN WESTERN ALASKA.

The data collected in the survey have been brought together in Table XXXIII, which shows the bed number, the sheet on which each bed is located, the kind of kelp, the area of the bed, the density of the growth, the tonnage, etc. The symbols used in this table are the same as used in Table XXXII, and therefore need no explanation.

TABLE XXXIII.—*Location, area, and tonnage of the surveyed kelp beds of western Alaska.*

Bed No.	Sheet.	Location.	Latitude.	Longitude.	Kind.	Density.	Length.	Width.	Area.	Tonnage.	Nearest shipping point.	Nearest anchorage.
			° ′ ″	° ′ ″			*Feet.*	*Feet.*	*Acres.*	*Tons.*		
[1] 1	....	Naked Island, Prince William Sound	60 35 00	147 20 00	N	VT	35,000	50	40.1	4,306	Valdez	North side of Naked Island.
[1] 2	....	Small Island south of Naked Island	60 34 00	147 23 00	N	VT	600	40	.55	120	...do	Do.
[1] 3	....	East end of Smith Island	60 32 00	147 20 00	N	T	900	50	1.03	335	...do	Northwest Harbor, Eleanor Island.
[1] 4	....	South side of Smith Island	60 32 00	147 22 00	N	T	500	30	.34	115	...do	Do.
[1] 5	....	.....do	60 32 00	147 23 00	N	T	500	30	.34	115	...do	Do.
[1] 6	....	South end of Little Smith Island	60 32 00	147 28 00	N	VT	700	60	.96	210	...do	Do.
[1] 7	....	North side Latouche Island	59 58 00	148 02 00	N	M	800	40	.73	320	Seward	Elrington Island behind small island north of west end.
[1] 8	....	Across southwest end of Latouche Island.	59 56 00	148 03 00	N	MH	1,400	200	6.42	5,600	...do	Do.
9	B	Renard Island near Seward	59 55 45	149 19 30	N	VT	900	70	1.44	175	...do	Resurrection Bay.
10	...do...	Resurrection Bay	59 55 45	149 18 30	N	T	2,640	10	.60	80	...do	Do.
11	...do...	Renard Island	59 55 00	149 21 30	N	M	2,500	50	2.86	2,000	...do	Do
12	...do...	.....do	59 54 15	149 22 00	N	M	1,800	40	1.65	1,500	...do	Do.
13	...do...	McArthur Pass, south side	59 27 00	150 20 00	N	T	1,000	10	.22	150	Seldovia	Cove in McArthur Pass.
14	...do...	Cove in Port Dick	59 14 45	151 00 00	N	MH	900	40	.82	800	...do	Sunday Harbor, Port Dick.
15	...do...	Sunday Harbor, Port Dick	59 16 00	151 00 00	Al	MH	1,200	50	1.37	1,800	...do	Do.
16	...do...	.....do	59 30 00	151 00 00	N, Al	VH	[2] 300	....	1.60	2,500	...do	Do.
17	...do...	Point Naskowhak	59 28 00	151 42 00	Al	M	400	10	.09	16	...do	Seldovia.
18	...do...	Seldovia Point	59 28 30	151 40 00	Al	VT	2,000	200	9.18	800	...do	Do.
19	...do...	Hesketh, Yukon, and Cohen Islands	59 31 30	151 30 00	Al	M	6,000	50	6.88	1,200	...do	Do.
20	...do...	Between Bluff Point and Anchor Point.	59 40 50	151 40 55	Al	H	[3] 6	([4])	1,920.0	501,811	...do	Coal Bay.
21	A	West end of Ban Island	58 21 30	152 55 00	Al	T	4,000	40	3.67	480	Kodiak	Paramanof Bay.
22	...do...	.....do	58 21 00	152 56 00	Al	M	4,000	200	18.36	3,200	...do	Do.
23	...do...	Cape Paramanof	58 19 00	153 04 00	Al	M	3,000	800	55.09	9,600	...do	Do.
24	...do...	Paramanof Bay	58 18 30	153 00 00	Al	T	250	50	.28	38	...do	Do.
25	...do...	.....do	58 18 00	152 59 00	Al	T	150	30	.10	14	...do	Do.
26	...do...	Alimvoak Bay	58 13 00	153 09 00	Al	T	400	30	.27	36	...do	Alimvoak Bay.
27	...do...	Raspberry Cape	58 03 30	153 26 00	Al	M	300	20	.13	48	...do	Ban Island.
28	...do...	Uganik Island	57 58 00	153 27 00	Al	VT	200	15	.06	6	...do	Viekoda Bay.
29	...do...	.....do	57 56 45	153 23 00	Al	VT	300	20	.13	12	...do	Do.
30	...do...	.....do	57 55 30	153 21 30	Al	M	800	200	3.67	640	...do	Do.
31	...do...	Outlet Cape	58 00 00	153 18 00	Al	T	6,000	[5] 15	2.00	270	...do	Do.
32	...do...	Dry Spruce Island	57 57 30	153 05 00	Al	T	800	100	1.83	240	...do	Ban Island.
33	...do...	Last Timber Point, Raspberry Island	57 58 30	152 58 00	Al	VT	200	25	.11	10	...do	Do.
34	...do...	Afognak	58 00 00	152 45 00	Al	M	8,000	800	148.07	25,600	...do	Afognak Bay.

[1] Not shown on map. [2] Feet diameter. [3] Miles. [4] One-half mile. [5] Average.

TABLE XXXIII.—*Location, area, and tonnage of the surveyed kelp beds of western Alaska*—Continued.

Bed No.	Sheet.	Location.	Latitude.	Longitude.	Kind.	Density.	Length.	Width.	Area.	Tonnage.	Nearest shipping point.	Nearest anchorage.
			° ′ ″	° ′ ″			*Feet.*	*Feet.*	*Acres.*	*Tons.*		
35	A	Hog Island	58 00 30	152 42 00	Al¾ N¼	H	5,000	60	6.88	5,475	Kodiak	Afognak Bay.
36	do	Fox Bay, Whale Island	57 59 00	152 46 00	Al	MH	600	100	1.37	300	do	Fox Bay.
37	do	Whale Island near Dolphin Point	57 59 00	152 44 00	Al	MH	800	80	1.4	320	do	Do.
38	do	Three Brothers, Marmot Bay	57 55 45	152 33 30	Al	H	1,200	120	3.3	864	do	Izhut Bay.
39	do	North end of Low Island	57 55 00	152 33 00	Al	T	200	50	.22	30	do	Uzinki.
40	do	Entrance Point	57 54 45	152 32 00	Al	M	250	40	.22	40	do	Do.
41	do	Rock west of Prodka Islet			Al	M	300	50	.34	60	do	Do.
	do	East end of Prodka Islet	57 54 45	152 31 00	Al						do	Do.
42	do	Course Point	57 53 30	152 28 00	Al	VT	400	40	.36	32	do	Do.
43	do	Reef west of Nelson Island			Al						do	Do.
	do	West end of Nelson Island			Al	M	900	100	2.06	360	do	Do.
	do	Rock south of Nelson Island	57 53 30	152 25 30	Al							Do.
44	do	Rock near South Point	57 53 15	152 22 30	Al	M	500	60	.68	120	Kodiak	Do.
45	do	Southeast end of Spruce Island	57 53 15	152 21 30	Al	MH	500	150	1.72	375	do	Do.
46	do	do	57 54 00	152 19 30	Al	MH	500	200	2.29	500	do	Do.
47	do	do	57 54 45	152 19 30	Al	MH	800	100	1.83	400	do	Do.
48	do	Long Island	57 47 00	152 16 00	Al	M	6,000	20	2.75	480	do	Long Island.
49	do	do	57 46 00	152 18 00	Al	M	12,000	25	6.88	1,200	do	Do.
50	do	do	57 44 45	152 18 30	Al	MH	1,500	500	17.21	3,750	do	Do.
51	do	do	57 45 00	152 17 00	Al	MH	2,000	150	6.88	1,500	do	Do.
52	do	do	57 46 00	152 15 30	Al	MH	2,500	100	5.73	1,250	do	Do.
53	do	do	57 47 30	152 14 30	Al	MH	4,000	600	55.09	12,000	do	Do.
54	do	Woody Island	57 47 30	152 19 00	Al	H	11,000	2,500	631.31	165,000	do	Kodiak.
55	do	do	57 45 30	152 20 00	Al	MH	2,500	30	1.72	375	do	Do.
56	do	Azimuth Point	57 52 15	152 26 30	Al	T	200	40	.18	24	do	Uzinki.
57	do	do	57 52 00	152 25 00	Al	T	250	50	.28	38	do	Do.
58	do	Termination Point	57 51 30	152 24 00	Al	M	1,000	200	4.59	800	do	Sycamore Bay.
59	do	Sycamore Bay	57 50 30	152 25 30	Al	M	150	20	.06	12	do	Do.
60	do	do	57 50 00	152 26 00	Al	M	250	50	.28	50	do	Do.
61	do	do	57 49 30	152 23 00	Al	MH	300	200	1.37	300	do	Do.
62	do	Miller Point	57 50 15	152 21 30	Al	MH	3,000	300	26.06	4,500	do	Do.
63	do	Spruce Cape	57 49 30	152 20 00	Al	H	5,000	800	91.82	24,000	do	Kodiak.
64	do	Southeast of Spruce Cape	57 48 30	152 20 00	Al	H	800	200	3.67	910	do	Do.
65	do	Woody Island	57 47 45	152 21 00	Al	M	1,200	50	1.37	240	do	Do.
66	do	Holiday Island	57 47 00	152 23 00	Al	M	600	40	.55	96	do	Do.
67	do	Hanin Rocks	57 49 30	152 18 30	Al	VT	1,000	300	6.88	600	do	Do.
68	do	Gull Island	57 46 45	152 26 00	Al	T	150	40	.13	18	do	Do.
69	do	Puffin Island	57 45 00	152 27 00	Al	T	200	50	.22	30	do	Do.
70	do	Rock southeast of Puffin Island	57 44 30	152 25 30	Al	M	250	40	.22	40	do	Do.
71	do	Rock northwest of Cliff Point	57 44 00	152 26 00	Al	M	200	50	.22	40	do	Do.
72	do	Cliff Point	57 43 30	152 27 00	Al	M	900	200	4.13	720	do	Do.

73	...do...	Reef near Broad Point	57 41 00	152 25 00	Al	M	1,000	150	3.42	600	...do	Kalsin Bay.
74	...do...	Queer Island	57 40 15	152 23 30	Al	M	200	100	.45	80	...do	Do.
75	...do...	Kalsin Island	57 40 00	152 24 00	Al	M	250	75	.43	75	...do	Do.
76	...do...	Kalsin Island to Jug Island	57 39 00	152 25 00	Al	M	1,500	300	10.33	1,800	...do	Do.
77	...do...	Kekur Island	57 38 30	152 20 00	Al	M	2,000	250	11.47	2,000	...do	Do.
78	...do...	Pinnacle Rock	57 39 00	152 21 00	Al	M	900	200	4.13	720	...do	Do.
79	...do...	Between Kekur and Pinnacle	57 38 45	152 21 00	Al	M	800	100	1.83	320	...do	Do.
80	...do...	Rock near Soitlak	57 38 00	152 22 00	Al	M	600	50	.68	120	...do	Do.
81	...do...	...do	57 37 00	152 23 00	Al	M	500	60	.68	120	...do	Do.
82	...do...	Rock in Kalsin Bay	57 38 00	152 24 00	Al	T	200	50	.22	30	...do	Do.
83	...do...	East point of Isthmus Bay	57 37 45	152 16 00	Al	M	800	150	2.75	480	...do	Do.
84	...do...	Near Cape Chiniak	57 37 15	152 14 00	Al	M	900	100	2.06	360	...do	Do.
85	...do...	...do	57 37 30	152 12 00	Al	MH	1,200	150	4.13	900	...do	Do.
86	...do...	Cape Chiniak	57 37 30	152 09 00	Al	MH	3,000	600	41.32	9,000	...do	Do.
87	...do...	Ugak Island	57 23 00	152 18 00	Al N	MH	2,000	100	4.59	2,850	...do	Ugak Bay.
88	...do...	Rock northeast of Cape Barnabas	57 10 00	152 48 00	N	M	100	50	.11	83	...do	Port Hobron.
89	...do...	Rock north of Cape Barnabas	57 11 00	152 51 00	Al	M	150	40	.13	24	...do	Do.
90	...do...	Island northeast of Cape Barnabas	57 11 00	152 52 30	Al	M	150	40	.13	24	...do	Do.
91	...do...	...do	57 11 00	152 54 00	Al	M	1,500	90	3.10	540	...do	Do.
92	...do...	Sitkalidak Strait	57 12 00	152 55 30	Al	VT	800	15	.27	24	...do	Do.
93	...do...	...do	57 13 00	152 57 00	Al	M	1,000	50	1.14	200	...do	Do.
94	...do...	...do	57 13 00	152 58 00	Al	VT	200	10	.04	4	...do	Do.
95	...do...	West end of Sitkalidak Island	57 04 40	153 24 00	Al	T	200	30	.13	18	...do	Three Saints Bay.
96	...do...	Three Saints Bay	57 06 40	153 27 00	Al	M	250	50	.28	50	...do	Do.
97	...do...	...do	57 06 40	153 27 00	N	VT	800	200	3.67	400	...do	Do.
98	...do...	Kaiugnak Bay	57 03 00	153 31 00	Al	M	600	40	.55	96	...do	Do.
99	...do...	Two Headed Island	56 52 40	153 38 00	Al	M	200	50	.22	40	...do	Do.
100	...do...	Aiaktalik Island and small island west of it.	56 42 00	154 09 00	Al	H	5 mi.	200	24.21	6,324	...do	Lazy Bay.
101	...do...	Cape Trinity	56 44 00	154 09 00	Al	M	10 mi.	50	60.60	10,559	...do	Do.
102	...do...	Aiaktalik Island	56 43 00	154 03 00	Al N	M	500	50	.57	256	...do	Do.
103	...do...	Geese Islands Straits	56 44 00	154 01 00	Al N	H	600	40	.55	438	...do	Do.
104	...do...	Geese Islands	56 44 00	153 57 00	Al N	H	6,000	500	68.87	54,750	...do	Do.
105	...do...	Geese Islands Straits	56 44 00	153 58 00	Al N	H	800	50	.91	730	...do	Do.
106	...do...	...do	56 45 00	153 55 30	Al N	H	1,400	60	1.92	1,533	...do	Do.
107	...do...	Geese Islands	56 42 00	153 57 00	Al N	H	9,000	600	123.96	98,550	...do	Do.
108	...do...	...do	56 44 00	153 54 30	Al N	VH	12,000	500	137.74	133,500	...do	Do.
109	...do...	...do	56 44 00	153 53 00	Al N	T	5,000	400	27.54	7,500	...do	Do.
110	...do...	...do	56 43 00	153 59 00	Al N	T	200	25	.11	31	...no	Do.
111	...do...	...do	56 42 00	153 59 00	Al N	H	9,000	1,500	309.91	246,375	...do	Do.
112	...do...	...do	56 43 00	154 00 00	Al N	H	4,500	3,000	309.91	245,375	...do	Do.
113	...do...	Aiaktalik Island	56 43 00	154 01 00	Al N	M	500	75	.86	384	...do	Do.
114	...do...	...do	56 43 00	154 01 30	Al N	M	300	40	.27	123	...do	Do.
115	...do...	...do	56 42 00	154 01 00	Al N	M	800	100	1.83	820	...do	Do.
116	...do...	...do	56 43 30	153 58 00	Al N	H	3,000	100	6.88	5,475	...do	Do.
117	...do...	Aiaktalik Island	56 41 00	154 00 00	Al N	M	3,000	150	10.33	4,613	...do	Do.
118	...do...	Low Cape, Kodiak Island	56 58 00	154 30 00	N	VT	18,500	4,500	1,910.92	208,125	...do	Do.
119	...do...	...do	56 59 00	154 30 00	N	M	6,000	6,000	826.21	594,000	...do	Do.
120	...do...	...do	57 00 00	154 30 00	N	VT	12,500	4,500	1,291.32	140,625	...do	Do.
121	...do...	Cape Ikolik, Kodiak Island	57 18 00	154 45 00	Al	M	1,000	10	.22	40	...do	Halibut Bay.
122	...do...	...do	57 17 00	154 43 00	Al	M	1,500	10	.34	60	...do	Do.
123	...do...	...do	57 21 00	154 45 00	Al	M	200	20	.09	16	...do	Do.

TABLE XXXIII.—*Location, area, and tonnage of the surveyed kelp beds of western Alaska*—Continued.

Bed No.	Sheet.	Location.	Latitude.	Longitude.	Kind.	Density.	Length.	Width.	Area.	Tonnage.	Nearest shipping point.	Nearest anchorage.
			° ′ ″	° ′ ″			*Feet.*	*Feet.*	*Acres.*	*Tons.*		
124	A	Kodiak Island northeast of Cape Ikolik.	57 25 30	154 43 00	Al	M	500	100	1.14	200	Kodiak	Larsens Bay.
125	do	Off Kodiak Island northeast of Cape Ikolik.	57 27 00	154 43 00	N	M	600	300	4.13	2,970	do	Do.
126	do	do	57 28 00	154 41 00	N	VT	500	200	2.29	250	do	Do.
127	do	Cape Karluk	57 35 00	154 31 00	Al	M	3,800	45	2.00	398	do	Do.
128	do	Bear Island	57 39 00	154 03 00	Al	M	200	30	.13	24	do	Do.
129	do	Harvester Island	57 38 30	154 02 00	Al	M	100	20	.04	8	do	Do.
130	do	do	57 39 00	154 01 00	Al	M	250	25	.14	25	do	Do.
131	do	Larsens Bay			Al	M	100	20	.04	8	do	Do.
132	do	Uyak Bay	57 38 00	153 53 00	Al	M	300	25	.17	30	do	Do.
133	do	do	57 42 00	153 56 00	Al	M	800	25	.45	80	do	Do.
134	do	West of Cape Kuliuk	57 45 00	153 56 00	Al	M	150	15	.05	9	do	Do.
135	do	do	57 47 00	153 56 00	Al	M	100	10	.02	4	do	Do.
136	do	Cape Ugat	57 52 00	153 52 00	Al	T	150	10	.03	5	do	Do.
137	do	Miners Point	57 54 00	153 44 00	Al	T	200	25	.11	15	do	Uganik Bay.
138	do	East Point	57 50 00	153 39 00	Al	VT	60	20	.02	2	do	Do.
139	do	West of Cape Uganik	57 56 00	153 33 00	Al	M	100	30	.06	12	do	Viekoda Bay.
140	do	do	57 57 00	153 33 00	Al	MH	600	250	3.44	750	do	Do.
141	do	do	57 58 00	153 31 00	Al	VT	300	20	.13	12	do	Do.
142	do	Raspberry Cape	58 04 00	153 25 00	Al	M	200	30	.13	24	do	Ban Island.
143	do	Alimvoak Bay	58 12 00	153 01 00	Al	M	150	20	.06	12	do	Alimvoak Bay.
144	do	do	58 12 00	153 3 00	Al	M	100	15	.03	6	do	Do.
145	do	Between Black Cape and Shuyak Strait.	58 24 00	152 53 00	Al	M	200	20	.09	16	do	Do.
146	do	do	58 23 00	152 51 00	Al	M	300	25	.17	30	do	Do.
147	do	do	58 24 00	152 52 00	Al	M	600	25	.34	60	do	Do.
148	do	do	58 24 00	152 50 00	Al	M	400	40	.36	64	do	Do.
149	do	do	58 24 00	152 49 00	Al	M	700	25	.40	70	do	Do.
150	do	do	58 24 00	152 48 00	Al	MH	6,000	200	27.54	6,000	do	Do.
151	do	do	58 26 00	152 48 00	Al	MH	4,500	500	51.65	11,250	do	Do.
152	do	do	58 26 00	152 46 00	Al	M	1,000	150	3.44	600	do	Do.
153	do	Shuyak Strait	58 31 00	152 38 00	Al	M	200	25	.11	20	do	Do.
154	do	do	58 31 00	152 37 00	Al	M	200	25	.11	20	do	Do.
155	do	do	58 28 00	152 38 00	Al	M	500	20	.22	40	do	Do.
156	do	do	58 31 00	152 35 30	Al	M	100	15	.03	6	do	Do.
157	do	do	58 31 00	152 34 00	Al	M	50	10	.01	2	do	Do.
158	do	do	58 28 00	152 33 00	Al	M	500	25	.28	50	do	Do.
159	do	do	58 28 30	152 29 00	Al	M	60	10	.01	2	do	Do.
160	do	do	58 28 00	152 29 00	Al	M	400	20	.18	32	do	Do.
161	do	do	58 28 30	152 28 00	Al	MH	4,000	15	1.37	300	do	Do.
162	do	Bigfort Island	58 29 00	152 27 00	Al	MH	12,000	100	27.54	6,000	do	Seal Bay.

163	...do...	Shuyak Island	58 31 00	152 24 00	Al	MH	4,500	150	15.51	3,375	...do	Do.
164	...do...	.....do	58 30 00	152 23 00	Al	MH	600	50	.68	150	...do	Do.
165	...do...	.....do	58 32 00	152 21 00	Al	MH	6,600	60	9.09	1,980	...do	Do.
166	...do...	.....do	58 35 00	152 21 00	Al	MH	5,000	50	5.73	1,250	...do	Do.
167	...do...	Posliedni Cape, Afognak Island	58 28 00	152 20 00	Al	VH	350	20	.16	49	...do	Do.
168	...do...	.....do	58 28 00	152 19 00	Al	M	250	40	.22	40	...do	Do.
169	...do...	.....do	58 27 30	152 19 30	Al	M	150	60	.20	36	...do	Do.
170	...do...	.....do	58 27 00	152 19 00	Al	M	400	30	.27	48	...do	Do.
171	...do...	.....do	58 27 00	152 18 00	Al	VH	350	50	.40	123	...do	Do.
172	...do...	Seal Islands	58 28 00	152 17 00	Al	VH	500	100	1.14	350	...do	Do.
173	...do...	.....do	58 27 00	152 17 00	Al	VH	800	150	2.75	840	...do	Do.
174	...do...	.....do	58 26 00	152 17 00	Al	VH	350	100	.80	175	...do	Do.
175	...do...	.....do	58 26 00	152 17 00	Al	M	900	250	5.16	900	...do	Do.
176	...do...	.....do	58 25 00	152 16 00	Al	M	500	150	1.72	420	...do	Do.
177	...do...	Tolstoi Point	58 25 00	152 10 00	Al	M	50	25	.03	5	...do	Do.
178	...do...	.....do	58 26 00	152 09 00	Al	M	200	10	.04	8	...do	Do.
179	...do...	Tonki Bay	58 23 00	152 04 00	Al	M	800	100	1.83	320	...do	Do.
180	...do...	Tonki Cape	58 21 30	152 00 00	Al	M	100	10	.02	4	...do	Izhut Bay.
181	...do...	.....do	58 22 00	151 59 00	Al	M	200	15	.06	12	...do	Do.
182	...do...	Marmot Strait	58 19 30	151 58 00	Al	M	150	10	.03	6	...do	Do.
183	...do...	.....do	58 18 00	151 59 00	Al	M	200	15	.06	12	...do	Do.
184	...do...	Marmot Island	58 14 30	151 54 30	Al	M	100	25	.05	10	...do	Do.
185	...do...	.....do	58 16 00	151 54 30	Al	M	200	50	.22	40	...do	Do.
186	...do...	.....do	58 16 00	151 53 30	Al	M	200	50	.22	40	...do	Do.
187	...do...	.....do	58 17 00	151 53 00	Al	VT	500	100	1.14	100	...do	Do.
188	...do...	Izhut Bay	58 09 30	152 19 30	Al	VT	40	10	.01	1	...do	Do.
189	...do...	Peril Cape	58 08 00	152 16 00	Al	M	100	10	.02	4	...do	Do.
190	...do...	.....do	58 08 00	152 17 00	Al	M	200	20	.09	16	...do	Do.
191	...do...	Izhut Cape	58 06 00	152 21 00	Al	M	150	10	.03	6	...do	Do.
192	...do...	.....do	58 06 00	152 22 00	Al	M	200	15	.06	12	...do	Do.
193	...do...	Duck Bay	58 07 00	152 23 00	Al	M	150	20	.06	12	...do	Do.
194	...do...	.....do	58 08 00	152 23 00	Al	T	50	30	.03	5	...do	Do.
195	...do...	.....do	58 07 00	152 24 00	Al	M	250	10	.05	10	...do	Do.
196	...do...	.....do	58 08 00	152 25 00	Al	M	250	20	.11	20	...do	Do.
197	...do...	.....do	58 08 00	152 25 00	Al	M	150	15	.05	9	...do	Do.
198	...do...	.....do	58 08 00	152 25 00	Al	M	100	10	.02	4	...do	Do.
199	...do...	Danger Bay	58 05 00	152 33 00	N	VT	2,000	20	9.18	1,000	...do	Uzinki.
200	...do...	.....do	58 05 00	152 38 00	N	VT	300	300	2.00	225	...do	Do.
201	...do...	.....do	58 04 00	152 38 00	Al	M	250	100	.57	100	...do	Do.
202	...do...	Afognak Bay	58 04 00	152 39 00	Al	M	250	60	.34	60	...do	Do.
203	...do...	.....do	58 03 00	152 40 00	Al	M	300	40	.27	48	...do	Do.
204	...do...	.....do	58 04 00	152 41 00	Al	M	200	30	.13	24	...do	Do.
205	...do...	.....do	58 04 00	152 42 00	Al	M	350	40	.31	56	...do	Do.
206	...do...	.....do	58 01 00	152 40 00	Al N	M	9,000	5,000	1033.05	461,250	...do	Do.
207	...do...	Whale Island	57 58 00	152 43 00	Al	MH	1,500	200	6.88	1,500	...do	Do.
208	...do...	Treeless Island	57 58 00	152 42 00	Al	MH	1,200	150	4.13	900	...do	Do.
209	...do...	Whale Island	57 57 00	152 42 00	Al	M	1,200	70	1.92	336	...do	Do.
210	...do...	.....do	57 57 00	152 43 00	Al	MH	800	150	2.75	600	...do	Do.
211	...do...	.....do	57 57 00	152 44 00	Al	M	300	100	.68	120	...do	Do.
212	...do...	.....do	57 56 00	152 43 00	Al	M	150	40	.13	24	...do	Do.
213	...do...	.....do	57 56 00	152 43 00	Al	M	200	50	.22	40	...do	Do.
214	...do...	.....do	57 56 00	152 43 00	Al	M	600	150	2.06	360	...do	Do.

TABLE XXXIII.—*Location, area, and tonnage of the surveyed kelp beds of western Alaska*—Continued.

Bed No.	Sheet.	Location.	Latitude.	Longitude.	Kind.	Density.	Length.	Width.	Area.	Tonnage.	Nearest shipping point.	Nearest anchorage.
			° ′ ″	° ′ ″			*Feet.*	*Feet.*	*Acres.*	*Tons.*		
215	A	Whale Island	57 55 00	152 43 00	Al	T	100	30	0.04	6	Kodiak	Uzinki.
216	do	do	57 55 00	152 43 00	Al	T	2,500	35	2.00	263	do	Do.
217	do	do	57 54 00	152 47 00	Al	T	300	20	.13	18	do	Do.
218	do	Ilkognak Rock	57 54 00	152 47 00	Al	T	100	20	.04	6	do	Do.
219	do	Inner Point	57 53 00	152 47 00	Al	T	200	20	.09	12	do	Do.
220	do	Willow Point	57 53 00	152 48 00	Al	T	40	10	.01	1	do	Do.
221	do	Kizhuyak Bay	57 50 00	152 54 00	Al	VT	100	20	.09	4	do	Do.
222	do	do	57 49 00	152 54 00	Al	VT	40	10	.01	1	do	Do.
223	do	Kekur Point	57 52 00	152 47 00	Al	VT	30	20	.01	1	do	Do.
224	do	Three Pillar Point	57 52 00	152 43 00	Al	VT	80	30	.05	5	do	Do.
225	do	Crag Point	57 53 00	152 40 00	Al	VT	60	40	.05	5	do	Do.
226	do	Kizhuyak Point	57 55 00	152 39 00	Al	M	300	10	.06	12	do	Do.
227	do	do	57 56 00	152 38 00	Al	M	200	100	.45	80	do	Do.
228	do	Shakmanof Point	57 56 00	152 35 00	Al	M	200	100	.45	80	do	Do.
229	do	Uzinki Point	57 55 00	152 32 00	Al	M	250	40	.22	40	do	Do.
230	do	Spruce Island	57 57 00	152 32 00	Al	M	400	40	.36	64	do	Do.
231	do	do	57 57 00	152 30 00	Al	M	200	25	.11	20	do	Do.
232	do	Wooded Island	57 57 30	152 30 00	Al	M	400	25	.22	40	do	Do.
233	do	Spruce Island	57 57 30	152 28 00	Al	M	800	300	5.51	960	do	Do.
234	do	The Triplets	57 59 00	152 29 00	Al	M	700	30	.48	84	do	Do.
235	do	Spruce Island	57 58 00	152 27 00	Al	T	400	15	.13	18	do	Kodiak.
236	do	do	57 55 00	152 22 00	Al	M	700	20	.31	56	do	Do.
237	do	do	57 55 00	152 21 00	Al	M	5,000	25	2.87	500	do	Do.
238	do	do	57 57 30	152 29 00	Al	T	300	20	.13	18	do	Do.
239	do	Kodiak Village	57 47 00	152 26 00	N	T	300	40	.27	114	do	Do.
240	do	Woody Island	57 46 00	152 22 00	Al	M	600	100	1.37	240	do	Do.
241	do	Near Island	57 47 00	152 24 00	Al	M	300	150	1.03	180	do	Do.
242	do	King Cove, Afognak Island	58 11 00	152 2 00	Al	M	1,000	35	.80	140	do	Izhut Bay.
243	do	Karluk	57 34 30	154 29 30	Al	VT	1,000	40	.91	80	do	Larsens Bay.
244	do	do	57 34 00	154 28 00	Al	VT	600	25	.34	30	do	Do.
245	B	Between Black Cape and Shuyak Strait.	58 29 00	152 46 00	Al	M	800	100	1.83	320	do	Alimvoak Bay.
246	do	Port Chatham	59 13 00	151 46 00	Al	VT	100	25	.05	5	Seldovia	Port Chatham.
247	do	Chatham Island	59 12 00	151 47 00	Al	VT	150	25	.08	8	do	Do.
248	do	Kelp Point, Port Chatham	59 12 00	151 49 00	Al	VT	1,000	60	1.37	120	do	Do.
249	do	Claim Point, Port Chatham	59 11 00	151 50 00	Al N	M	1,500	66	2.27	1,015	do	Do.
250	do	West of Port Chatham	59 12 00	151 51 00	Al N	M	150	15	.05	23	do	Do.
251	do	do	59 12 00	151 53 00	Al N	M	200	15	.06	4	do	Do.
252	do	do	59 13 00	151 56 00	Al N	M	250	20	.11	51	do	Do.
253	do	English Bay	59 21 00	151 58 00	Al N	M	500	150	1.72	769	do	Port Graham.
254	do	do	59 22 00	151 57 00	Al N	MH	....	....	....	....	do	Do.
255	do	Port Graham	59 23 00	151 56 00	Al N	VH	2,500	300	17.22	16,688	do	Do.

256	...do...	.....do	59 23 00	151 55 00	Al N	M	400	30	.27	48	...do	Do.
257	...do...	.....do	59 23 00	151 55 00	Al N	M	350	20	.16	72	...do	Do.
258	...do...	.....do	59 22 00	151 55 00	Al	M	200	15	.06	12	...do	Do.
259	...do...	.....do	59 23 00	151 57 00	Al	M	400	25	.22	40	...do	Do.
260	...do...	.....do	59 23 00	151 56 00	Al N	MH	1,000	200	4.59	2,850	...do	Do.
261	...do...	.....do	59 24 00	151 56 00	Al N	MH	300	50	.34	214	...do	Do.
262	...do...	East of Port Graham	59 25 00	151 55 00	Al	M	300	25	.17	30	...do	Do.
263	...do...	.....do	59 26 00	151 50 00	Al	T	2,000	10	.45	60	...do	Do.
264	...do...	Seldovia Bay	59 28 00	151 44 00	Al N	M	250	10	.05	25	...do	Seldovia.
265	A	Cape Atushagvik	58 04 30	154 21 00	Al	VH	2,500	150	8.61	2,625	Kodiak	Russian Anchorage.
266	...do...	Russian Anchorage	58 06 00	154 23 00	Al	M	200	25	.55	20	...do	Do.
267	...do...	.....do	58 06 00	154 22 00	Al N	M	150	10	.03	15	...do	Do.
268[1]		Nakchamik Island	56 22 00	157 49 00	Al	H	400	60	.55	120	Chignik	Chignik.
269[1]		.....do	56 22 00	157 51 30	Al	M	300	15	.10	18	...do	Do.
270[1]		.....do	56 21 00	157 54 00	Al	M	200	15	.06	12	...do	Do.
271[1]		.....do	56 20 00	157 54 00	Al	H	600	75	1.03	270	...do	Do.
272	B	Mitrofania Bay	56 01 00	158 49 00	Al	T	700	60	.96	126	...do	Mitrofania Bay.
273	...do...	.....do	55 59 00	158 46 00	Al	T	1,000	15	.34	45	...do	Do.
274	...do...	.....do	55 59 00	158 50 00	Al	T	250	20	.11	15	...do	Do.
275	...do...	Coal Cape	55 54 00	158 59 00	Al	T	100	10	.02	3	...do	Do.
276	...do...	.....do	55 54 00	159 00 00	Al	T	100	10	.02	3	...do	Do.
277	...do...	Pinusuk Island	55 51 30	159 02 00	Al	T	350	35	.28	....	...do	Do.
278	...do...	Chiachi Island	55 52 00	159 05 00	Al	T	200	20	.09	12	...do	Do.
279	...do...	Point west of Coal Cape	55 52 00	159 14 00	Al	T	100	15	.03	45	...do	Do.
280	...do...	East of Fox Cape	55 39 00	159 28 00	Al	T	150	20	.06	9	Sand Point	Ivanof Bay.
281	...do...	Fox Cape	55 38 00	159 29 00	Al	T	100	15	.03	5	...do	Do.
282	...do...	Fox Bay	55 40 00	159 38 00	Al	M	800	25	.45	80	...do	Do.
283	...do...	Korovin Island	55 29 00	160 06 00	Al N	M	300	100	.68	308	...do	Pirate Cove.
284	...do...	.....do	55 28 00	160 05 00	Al	VT	400	20	.18	16	...do	Do.
285	...do...	.....do	55 27 00	160 04 00	Al	VT	900	20	.41	36	...do	Do.
286	...do...	.....do	55 25 00	160 04 00	Al	M	300	60	.41	72	...do	Do.
287	...do...	.....do	55 24 00	160 04 00	Al N	M	400	100	.91	410	...do	Do.
288	...do...	.....do	55 24 00	160 05 30	Al N	VH	600	150	2.06	2,003	...do	Do.
289	...do...	.....do	55 24 45	160 09 00	Al	M	2,000	40	1.83	320	...do	Do.
290	...do...	.....do	55 25 00	160 10 00	Al N	H	200	150	.68	548	...do	Do.
291	...do...	.....do	55 25 00	160 12 00	Al	M	600	200	2.75	480	...do	Do.
292	...do...	.....do	55 25 00	160 13 00	Al	H	800	60	1.10	288	...do	Do.
293	...do...	.....do	55 25 00	160 15 00	Al	M	6,000	20	2.75	480	...do	Do.
294	...do...	Popof Island	55 22 00	160 18 00	Al	T	250	25	.14	19	...do	Do.
295	...do...	.....do	55 22 00	160 21 00	Al	T	200	20	.09	12	...do	Do.
296	...do...	.....do	55 22 00	160 22 00	Al	M	350	20	.16	28	...do	Do.
297	...do...	.....do	55 21 30	160 23 00	Al	M	200	20	.09	16	...do	Do.
298	...do...	.....do	55 21 30	160 24 00	Al	M	300	15	.10	18	...do	Do.
299	...do...	.....do	55 22 00	160 29 00	Al	M	400	15	.13	24	...do	Sand Point.
300	...do...	.....do	55 22 00	160 31 00	Al	VH	3,000	600	41.32	12,600	...do	Do.
301	...do...	.....do	55 22 00	160 31 30	Al	VH	1,000	150	3.44	1,050	...do	Do.
302	...do...	Unga Island	55 23 00	160 32 00	Al	H	1,200	250	6.88	1,800	...do	Do.
303	...do...	.....do	55 24 00	160 32 00	Al	M	800	40	.73	128	...do	Do.
304	...do...	.....do	55 24 00	160 33 00	Al	T	4,000	25	2.29	300	...do	Da.

[1] Not shown on map.

TABLE XXXIII.—*Location, area, and tonnage of the surveyed kelp beds of western Alaska*—Continued.

Bed No.	Sheet.	Location.	Latitude.	Longitude.	Kind.	Density.	Length.	Width.	Area.	Tonnage.	Nearest shipping point.	Nearest anchorage.
			° ′ ″	° ′ ″			*Feet.*	*Feet.*	*Acres.*	*Tons.*		
305	B	Unga Island	55 25 00	160 40 00	Al N	M	300	50	0.34	154	Sand Point	Zachary Bay.
306	do	do	55 24 00	160 43 00	Al N	T	600	50	.68	188	do	Do.
307	do	do	55 24 00	160 45 30	Al N	M	1,000	200	4.59	2,050	do	Do.
308	do	do	55 24 00	160 48 00	Al N	M	12,000	5,000	1,377.18	615,000	do	Do.
309	do	do	55 23 30	160 40 00	Al	M	600	90	1.23	216	do	Do.
310	do	do	55 22 30	160 40 00	Al	VT	1,000	25	.57	50	do	Do.
311	do	do	55 23 00	160 38 00	Al	VT	600	15	.02	18	do	Do.
312	do	do	55 24 00	160 37 00	Al	VT	200	25	.11	10	do	Do.
313	do	Popof Island	55 21 00	160 32 00	Al	M	400	20	.18	32	do	Sand Point.
314	do	Unga Island	55 21 00	160 32 30	Al	H	350	150	1.25	26	do	Do.
315	do	do	55 21 00	160 33 00	Al	M	60	10	.01	2	do	Do.
316	do	Popof Island	55 19 00	160 32 45	Al	M	300	20	.13	24	do	Do.
317	do	do	55 16 00	160 22 45	Al	M	200	10	.04	8	do	Do.
318	do	Unga Island	55 20 00	160 35 00	Al	T	400	20	.18	24	do	Do.
319	do	Korovin Island	55 28 03	160 14 30	Al	M	300	80	.55	100	do	Do.
320	do	do	55 28 03	160 14 30	Al	M	1,000	150	3.44	600	do	Do.
321	do	do	55 28 03	160 14 30	Al	M	1,500	100	3.44	600	do	Do.
322	do	Karpa Island	55 32 00	159 58 00	Al	M	350	100	.80	140	do	Do.
[1]323		Paul Island	55 45 00	159 14 00	Al	M	300	50	.34	60	do	Kupreanof Harbor.
[1]324		do	55 45 00	159 14 00	Al	M	800	100	1.83	320	do	Do.
325	B	Mitrofania Island	55 53 00	158 46 00	Al	M	500	200	2.29	400	Chignik	Mitrofania Bay.
326	do	do	55 53 00	158 46 00	Al	MH	400	200	1.83	400	do	Do.
[1]327		Unavishak Island	56 29 00	157 42 00	Al N	MH	500	200	2.29	1,425	do	
[1]328		do	56 29 00	157 42 00	Al	M	700	150	2.41	420	do	
[1]329		Takli Island			Al	M	300	100	.68	120	Kodiak	Amalik Bay.
[1]330		do			Al	M	500	150	1.72	300	do	Do.
331	A	do			Al N	M	500	150	1.72	769	do	Do.
332	do	do	58 05 00	154 25 00	Al	M	400	100	.91	160	do	Do.
333	do	do		154 30 00	Al	M	800	200	3.67	640	do	Do.
334	do	do			Al	M	600	200	2.75	480	do	Do.
335	do	do			Al	T	200	50	.22	30	do	Do.
336	do	do			Al	M	700	200	3.21	560	do	Do.
337	do	Cape Gull Rocks	58 11 00	154 09 00	Al	M	600	250	3.44	600	do	Kukak Bay.
338	do	do	58 11 00	154 09 00	Al	M	300	100	.68	120	do	Do.
339	do	do	58 11 00	154 09 00	Al	M	200	150	.68	120	do	Do.
340	do	do	58 11 00	154 09 00	Al	M	500	100	1.14	200	do	Do.
341	do	Kukak Bay	58 21 00	154 01 00	Al	MH	400	100	.91	200	do	Do.
342	do	do	58 21 00	154 01 00	Al	M	200	150	.68	120	do	Do.
343	do	Cape Nukshak	58 23 00	153 57 00	Al	MH	500	100	1.14	250	do	Do.
344	B	Seldovia Point	59 26 00	151 53 00	N	MH	10,000	1,200	275.48	282,000	Seldovia	Seldovia.
[1]345		Kenai Peninsula	59 09 00	151 46 00	N	M	600	200	2.75	1,980	do	Port Dick.

346	B	....do	59 09 00	151 46 00	N	M	400	120	1.10	791	...do	Do.
347	...do...	....do	59 08 00	151 46 00	Al N	M	300	100	.68	308	...do	Do.
348	...do...	....do	59 09 00	151 34 00	Al N	M	400	150	1.37	615	...do	Do.
349	...do...	....do	59 09 00	151 34 00	Al	M	150	40	.13	24	...do	Do.
350	...do...	....do	59 09 00	151 34 00	Al N	M	250	150	.86	384	...do	Do.
351	...do...	East Chugach Island	59 08 00	151 30 00	Al N	M	200	75	.34	154	...do	Do.
352	...do...	....do	59 08 00	151 30 00	Al	MH	250	100	.57	125	...do	Do.
353	...do...	....do	59 08 00	151 30 00	N	H	300	150	1.03	1,373	...do	Do.
[1] 354		Macleod Harbor	59 53 00	147 58 00	N	M	350	50	.40	289	Seward	**Macleod Harbor.**
[1] 355		....do	59 53 00	147 58 00	N	H	300	100	.68	915	...do	Do.
[1] 356		....do	59 53 00	147 58 00	N	MH	400	75	.68	705	...do	Do.
[1] 357		....do	59 53 00	147 58 00	N	H	600	150	2.06	2,745	...do	Do.
[1] 358		Montague Island	59 50 00	147 58 00	N	T	250	100	.57	238	...do	Do.

[1] Not shown on map.

The equivalents of the symbols of density are given in Table XXXIV. The tonnage estimates in Table XXXIII and also those following are based on these values.

TABLE XXXIV.—*Estimated yield per square foot of beds of commercially important varieties of kelp.*

Grades.	Weight of plants per square foot.		
	Nereocystis luetkeana.	Alaria fistulosa.	Alaria and Nereocystis.
	Pounds.	*Pounds.*	*Pounds.*
Very heavy (VH)	75	14	44½
Heavy (H)	61	12	36½
Medium heavy (MH)	47	10	28½
Medium (M)	33	8	20½
Thin (T)	19	6	12½
Very thin (VT)	5	4	4½

On this basis the writer estimates the amount of kelp in the area covered by this report at 3,567,000 tons. Of this, 1,251,200 tons are in beds of pure Nereocystis, 1,457,300 tons are in beds of mixed Nereocystis and Alaria, while 858,500 tons are in beds of pure Alaria. About 90 per cent of this kelp is water. The average potash (K_2O) content of the Nereocystis samples submitted from this expedition was 20.6 per cent of the dry weight and of Alaria 5.95 per cent. This would indicate that there should be an annual production of at least 41,200 tons of potassium chloride in the pure Nereocystis beds, 8,170 tons from the pure Alaria beds, and 30,900 tons in the mixed beds. This gives a total of 80,300 tons of potassium chloride available from the beds mapped in western Alaska.

At current prices for potassium chloride of the grades corresponding to dried kelp, the annual value of the harvest from the beds surveyed by the author would be in excess of $3,000,000 without allowing any value for the nitrogen content. Since, however, there is little doubt that the nitrogen content would command a value commensurate with other nitrogenous fertilizers, it seems safe to estimate the value of the possible kelp harvest from western Alaska as upward of $4,500,000.

Some portions of Prince William Sound and the western portion of the Shumagin Islands are still unmapped. No mapping at all was done west of the Shumagin Islands. It is known that there are large quantities of kelp west of these islands and at certain places in the Bering Sea. The north and west shores of Shuyak Island were not visited because of the strong tides prevailing there and the fact that the region is unsurveyed. Some portions of the Alaska Peninsula, Kodiak Island, and the Barren Islands also had to be omitted on account of weather conditions prevailing at the time of our visits to these places.

It seems probable that the volcanic eruption of Mount Katmai in June, 1912, interfered a good deal with the kelp crop in Shelikof Strait in 1912 and 1913. Martin (National Geographic Magazine, February, 1913), says that in August, 1912, the kelp seemed to be dead as far east as the eastern end of Afognak Island. The beds seem to be gradually recovering from the effects of the fumes, ash, and pumice ejected in this eruption, and in a few years they will probably have fully recovered their former density.

USE OF KELP AS FERTILIZER.

The use of kelp as a fertilizer for potato beds seems to be universal among the natives of the villages of Kodiak, Afognak, and Uzinki and at some other places on Kodiak and Afognak and Woody Islands. (Pls. I, II, III.) The writer made diligent inquiry and did not learn of a single instance where natives had planted potatoes without using kelp as fertilizer.

When they gather fresh material from the water and bring it ashore in their dories they seem to use *Alaria fistulosa* universally, but when they use material cast up on the beach, they use whatever they find. Often this beach drift included Alaria, Nereocystis, Laminaria, Fucus (rockweed), Cymathaere, and other kelps.

Kelp is also used as a fertilizer by white citizens of Alaska. Superintendent George A. Learn of the Baptist Orphanage on Woody Island has used it more largely than anyone else of whom the writer learned. He obtains a good deal of his supply from drift kelp on the beach.

The method used by natives for planting potatoes with kelp as fertilizer is as follows:

The ground is first spaded up and ridges are thrown up where paths between the beds are to be. The beds are then covered with a layer of fresh kelp from 1 to 3 or even 4 inches deep. The dirt from the ridges is then thrown onto the beds, completely covering the kelp. These beds vary somewhat in size, but are frequently about 30 feet by 3 feet. The gardener smooths the surface and the sides of the beds very evenly with a shovel and then plants the potatoes by making a hole with a stick down to the layer of kelp, placing the cut piece of potato in this hole and covering it with soil. Sometimes the potatoes are sprouted before placing them in these holes, but usually not. Little or no cultivation seems to be necessary in growing potatoes in this region. This may be due in part to the fact that no weed seeds are brought into the soil with the fertilizer used. Prior to the volcanic eruption of 1912 a good many cows were kept in this region, but the natives do not seem to have formed the habit of using manure as fertilizer.

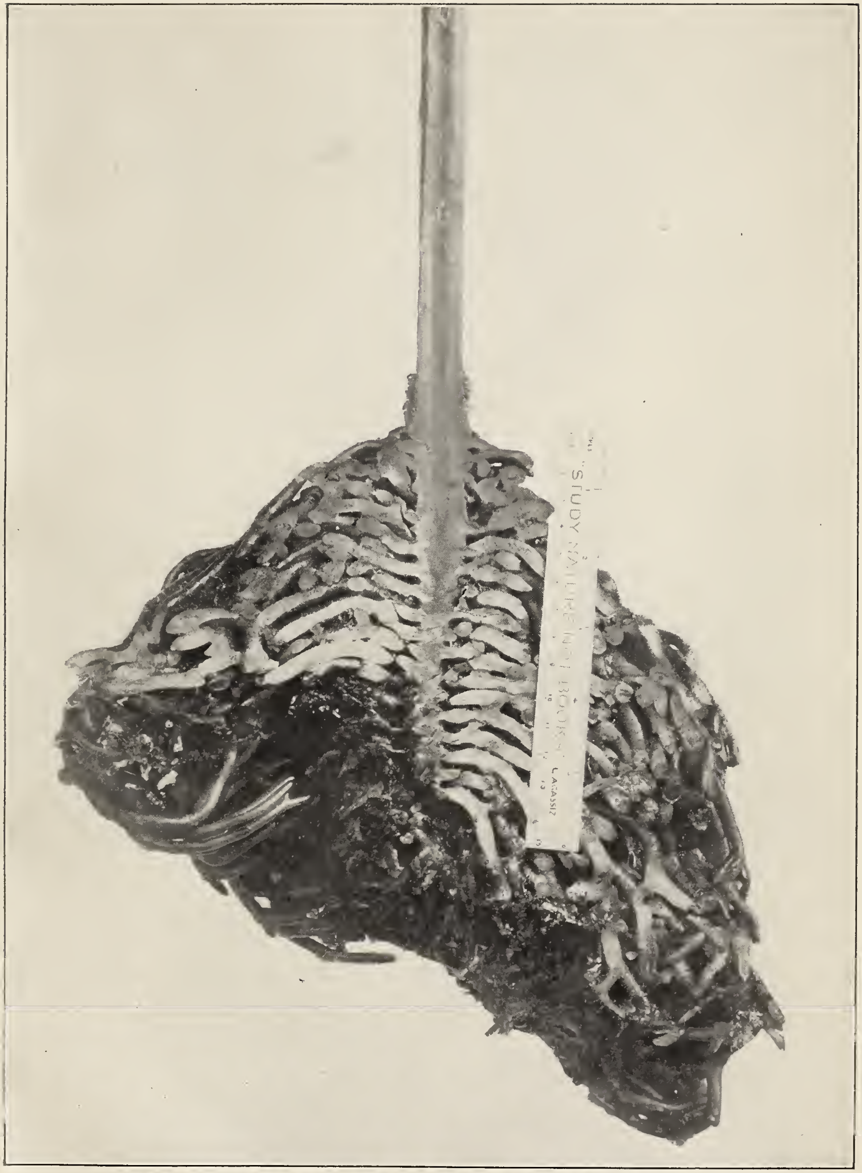
From the fact that the use of kelp as fertilizer is considered a necessary condition for raising potatoes, the potato patches are all located near the beach. This location may also be influenced by the convenience of taking the crop away in a dory. There are but few horses kept in this region, there being only one team in Kodiak village. If the kelp fertilizer were dried and sacked, it could be easily used on lands farther from the beach. Some patches of potatoes have been grown by the whites on the higher ground back from the beach, with good results.

One of the problems of this region at present is that of producing on the newly deposited soil that covers the region sufficient forage to enable the people to resume the keeping of cows. A considerable herd of cattle had been kept at the Government experiment station at Kalsin Bay, 15 miles from Kodiak, up to the time of the eruption, but these had to be taken elsewhere immediately following the fall of ash. Analysis of this volcanic ash shows that it contains nothing injurious to crops. It will, however, require a liberal use of fertilizer to insure continued production of crops. This offers an excellent opportunity to make practical tests of kelps as fertilizer. Should such experiments prove successful, it would be a great boon to the country.

RELATION OF SALMON CANNERIES TO KELP BEDS.

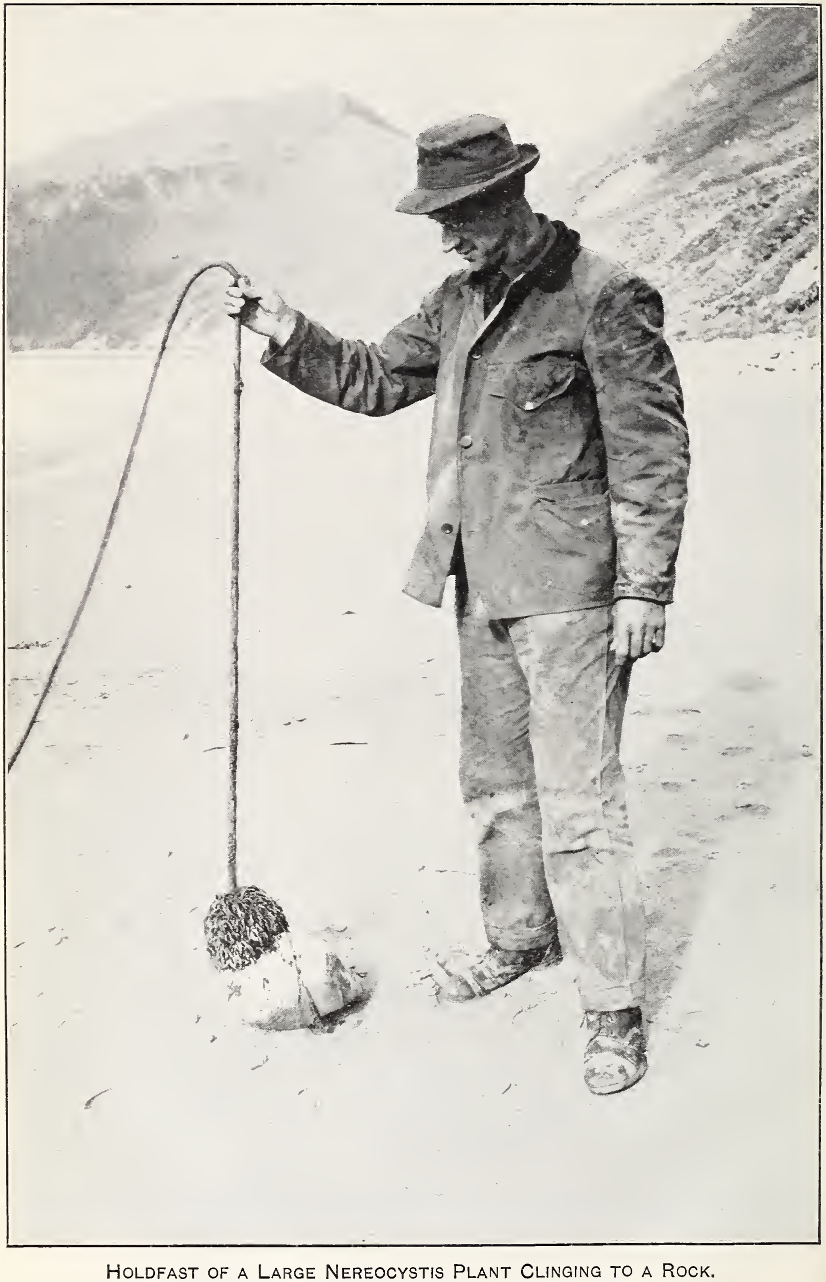
Several of the salmon canneries of western Alaska are located near large kelp beds. Among these are the cannery of the Kadiak Fisheries Co. at Kodiak, the cannery of the Seldovia Salmon Co. at Seldovia, the cannery of the Alaska Packers' Association at Alitak, on Olga Bay (an indentation of the southwest shore of Kodiak Island) and of the Fidalgo Island Packing Co. at Port Graham.

O



VERTICAL SECTION OF A LARGE HOLDFAST OF NEREOCYSTIS.

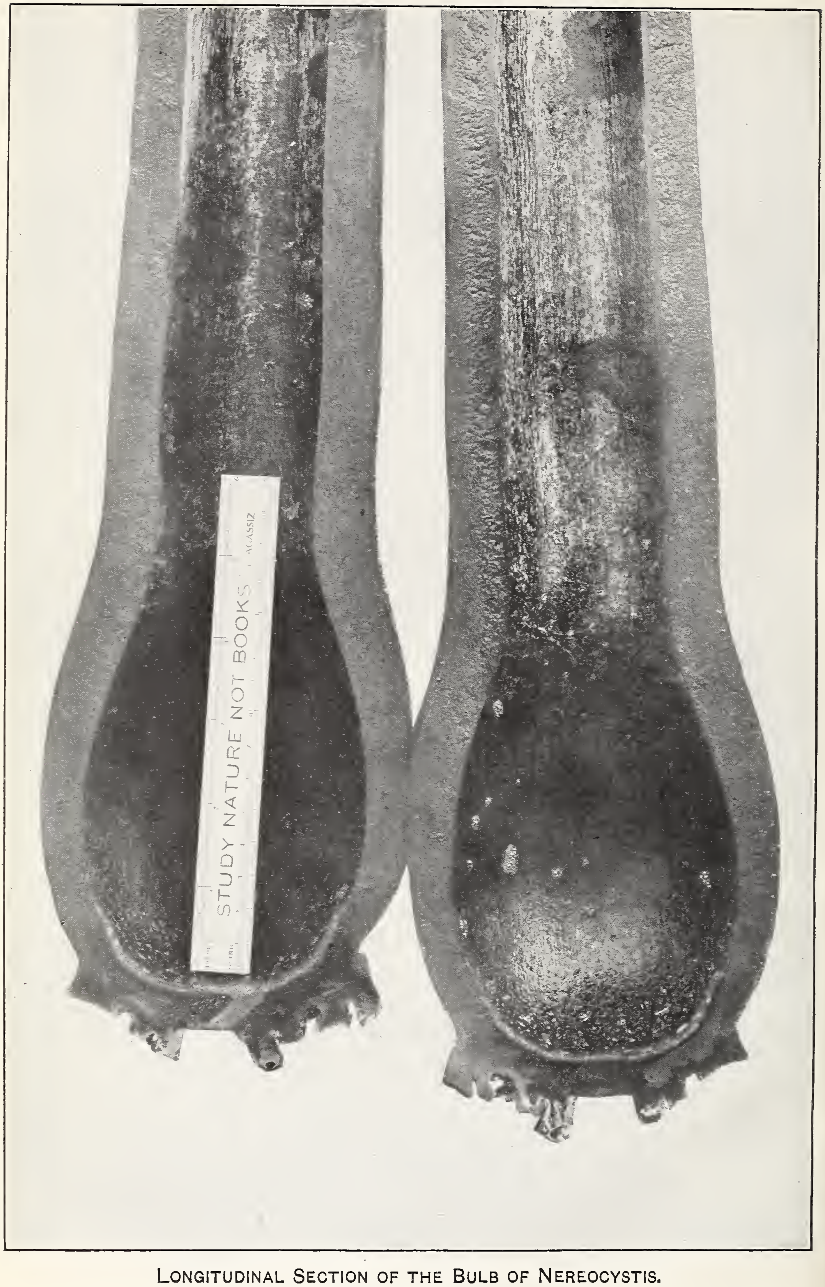
[Photograph by S. M. Zeller.]



HOLDFAST OF A LARGE NEREOCYSTIS PLANT CLINGING TO A ROCK.
[Collected near Low Cape, Kodiak Island. Photograph by S. M. Zeller.]

LARGE NEREOCYSTIS PLANT COLLECTED NEAR LOW CAPE, KODIAK ISLAND.

[Note holdfast on ground at extreme right. Photograph by S. M. Zeller.]

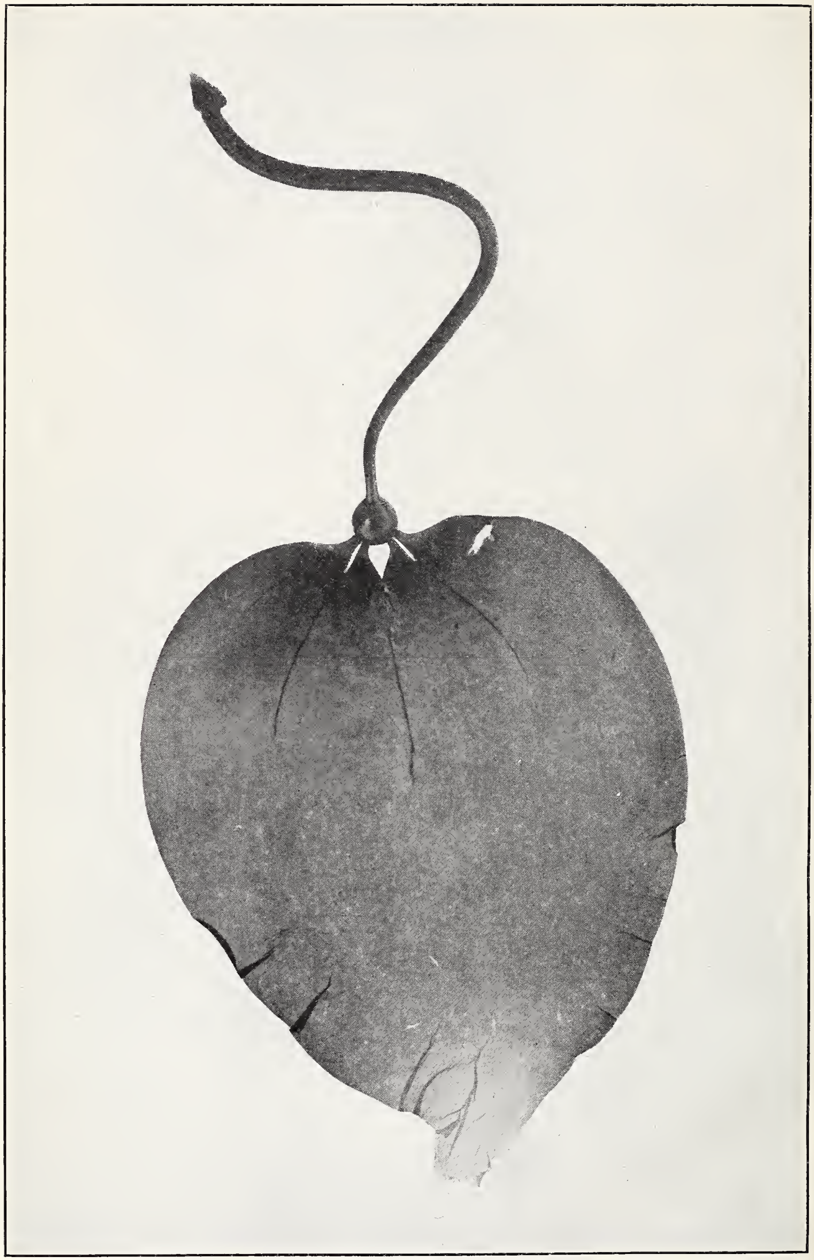


LONGITUDINAL SECTION OF THE BULB OF NEREOCYSTIS.

[Photograph by S. M. Zeller.]

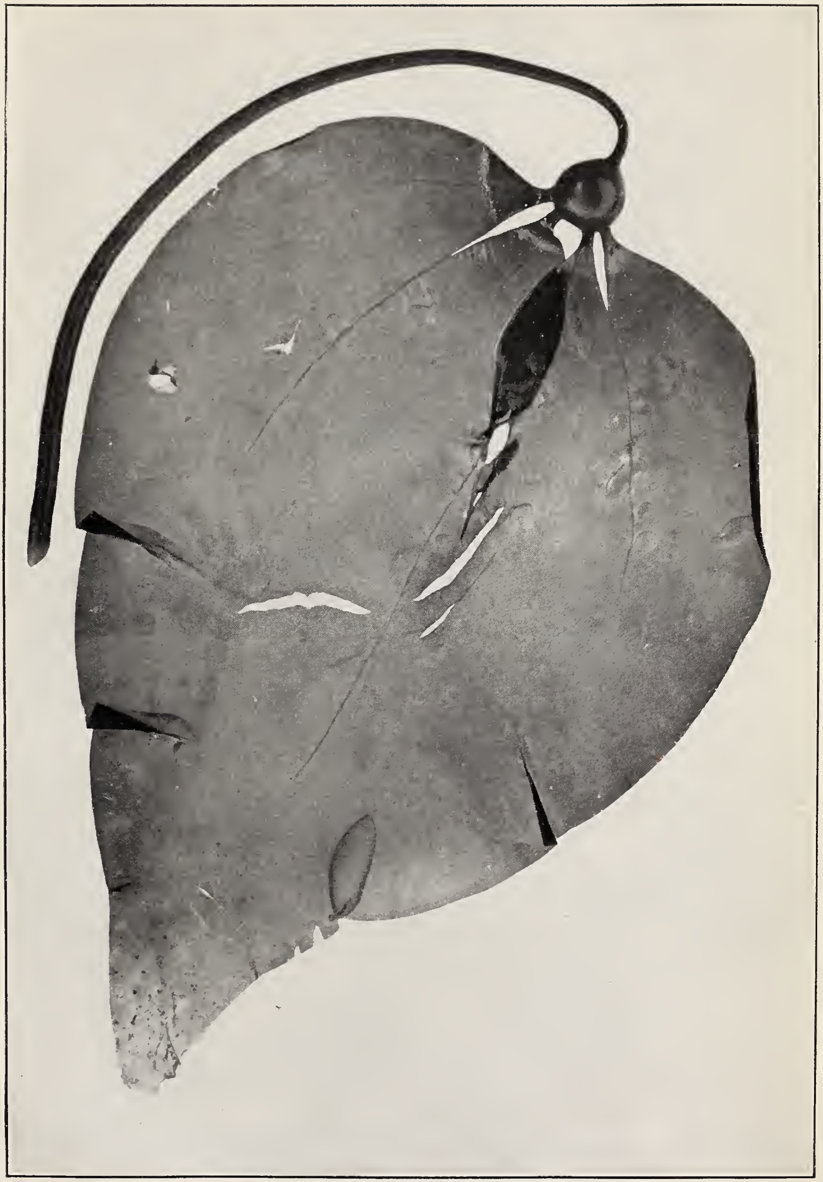
A YOUNG NEREOCYSTIS PLANT COLLECTED AT THREE SAINTS BAY, KODIAK ISLAND.

[Photograph by S. M. Zeller.]

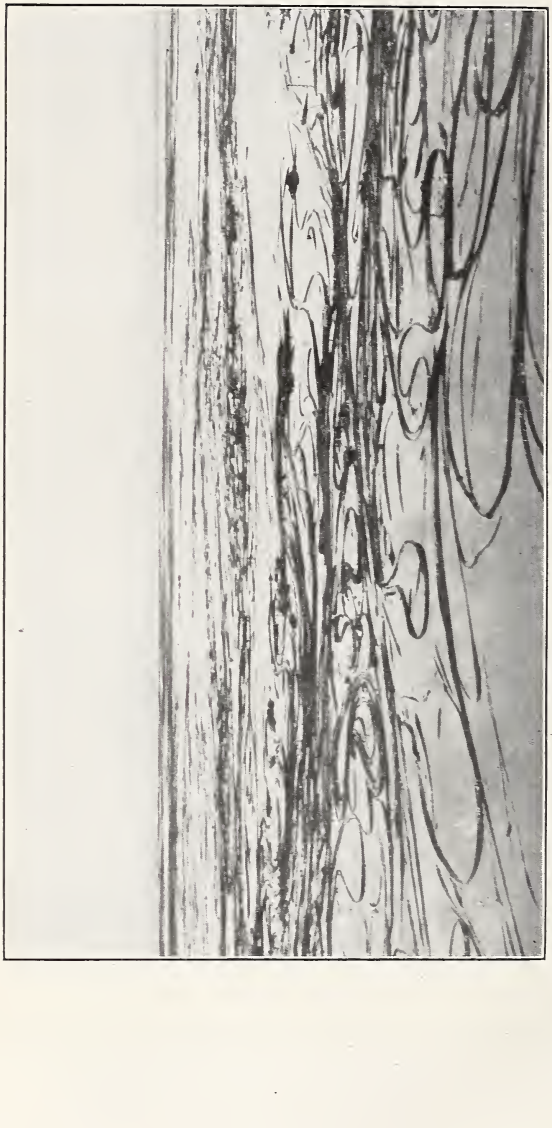


A JUVENILE NEREOCYSTIS PLANT (NATURAL SIZE), KODIAK, ALASKA.

[Photograph by S. M. Zeller.]



A JUVENILE NEREOCYSTIS PLANT.
[Photograph by S. M. Zeller.]

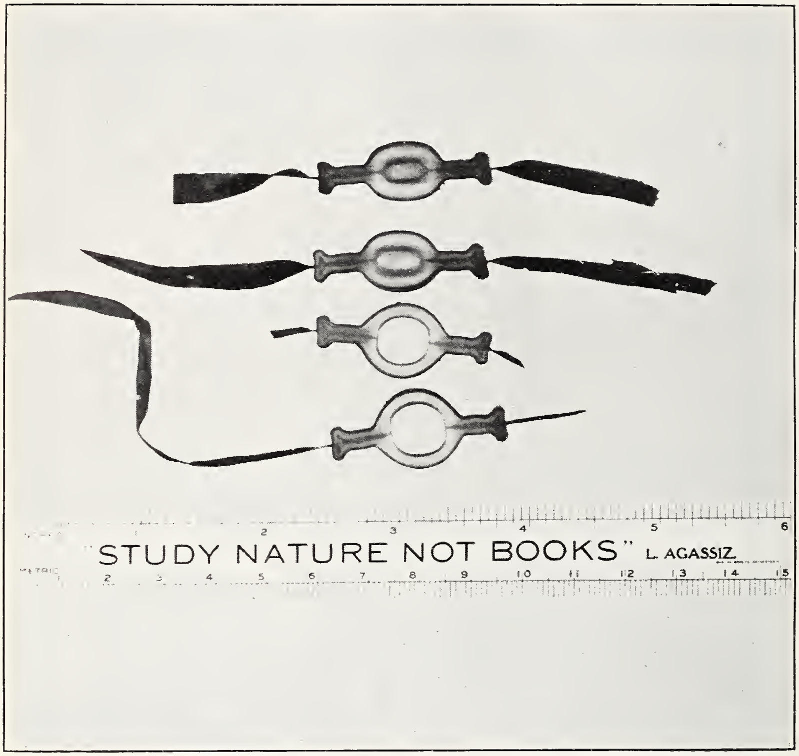


BED OF ALARIA, NEAR VIEW, GEESE ISLANDS.

[Photograph by Robert F. Griggs.]

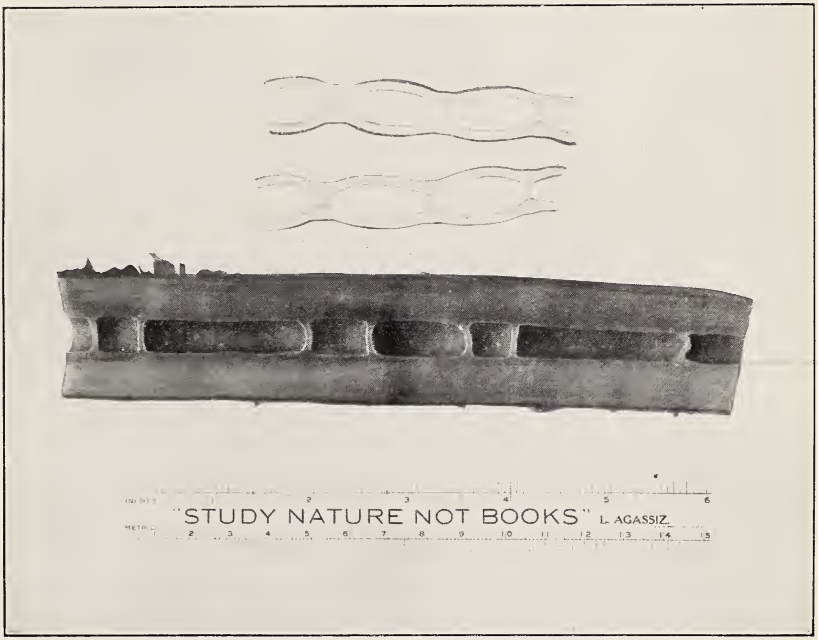
PORTION OF LEAF OF ALARIA FISTULOSA, SHOWING MIDRIB.

[Photograph by S. M. Zeller.]



CROSS SECTIONS OF MIDRIB OF ALARIA FISTULOSA.

[Photograph by S. M. Zeller.]

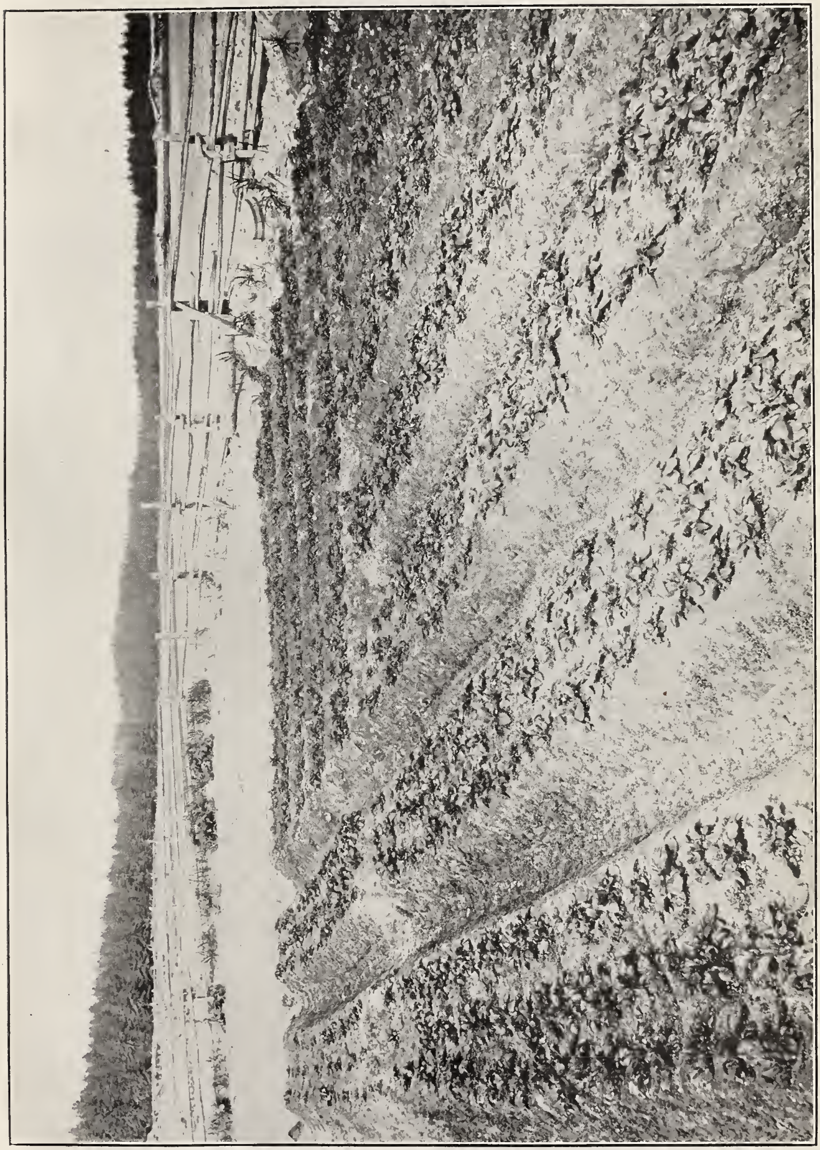


LONGITUDINAL SECTION OF THE MIDRIB OF ALARIA FISTULOSA.

[Photograph by S. M. Zeller.]

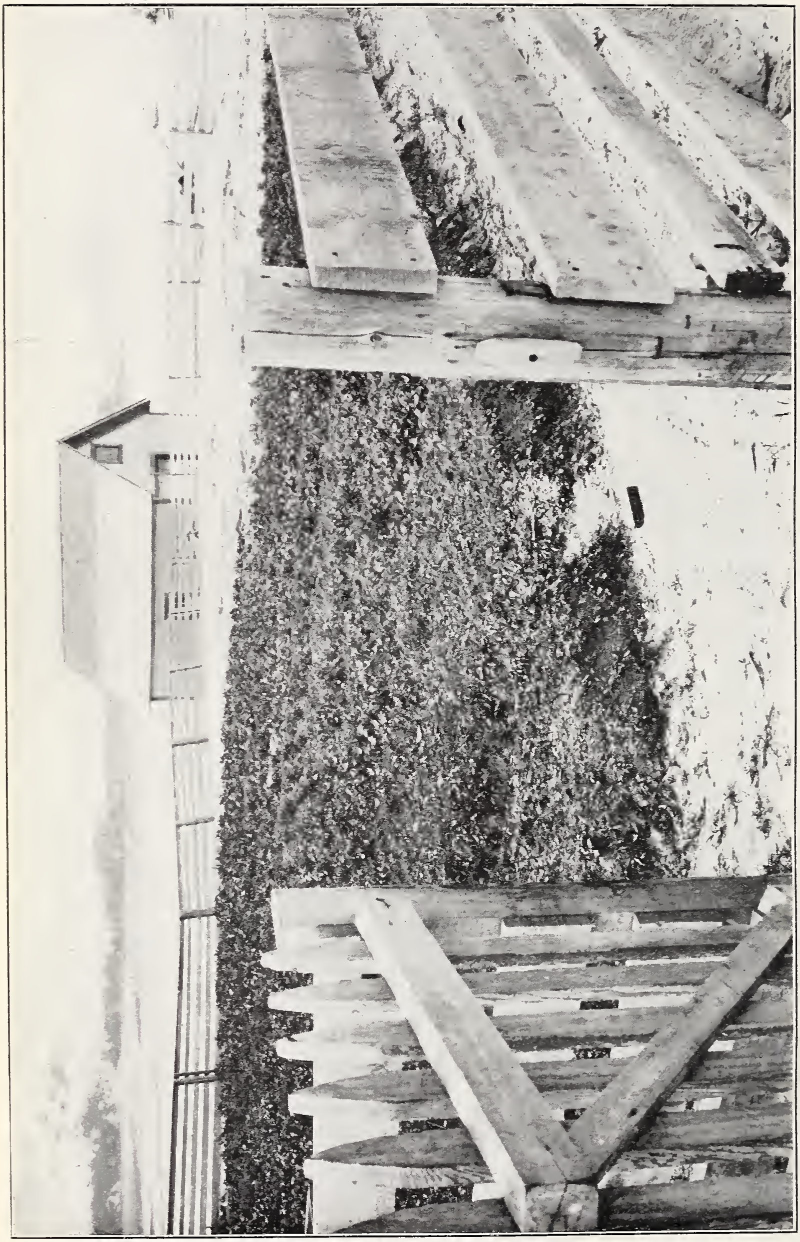
POTATO GARDENS FERTILIZED WITH GREEN KELP, KODIAK, ALASKA.

[Photograph by S. M. Zeller.]



CLOSER VIEW OF POTATO GARDEN, KODIAK, ALASKA.

[Photograph by S. M. Zeller.]



MR. ERSKINE'S POTATO GARDEN, KODIAK, ALASKA.

[Photograph by S. M. Zeller.]

KELP HARVESTER, END VIEW, SHOWING CUTTING DEVICE IN WATER, CONVEYOR, AND ENGINE.

[Photograph by George H. Ennis.]

HOPPER THROUGH WHICH THE HARVESTED KELP FALLS AND IS CUT INTO SHORT LENGTHS.

[Photograph by George H. Ennis.]

VIEW SHOWING HOPPER AND CONVEYOR CARRYING THE KELP, WHICH HAS BEEN CUT INTO SHORT LENGTHS, TO LOADING BARGE.

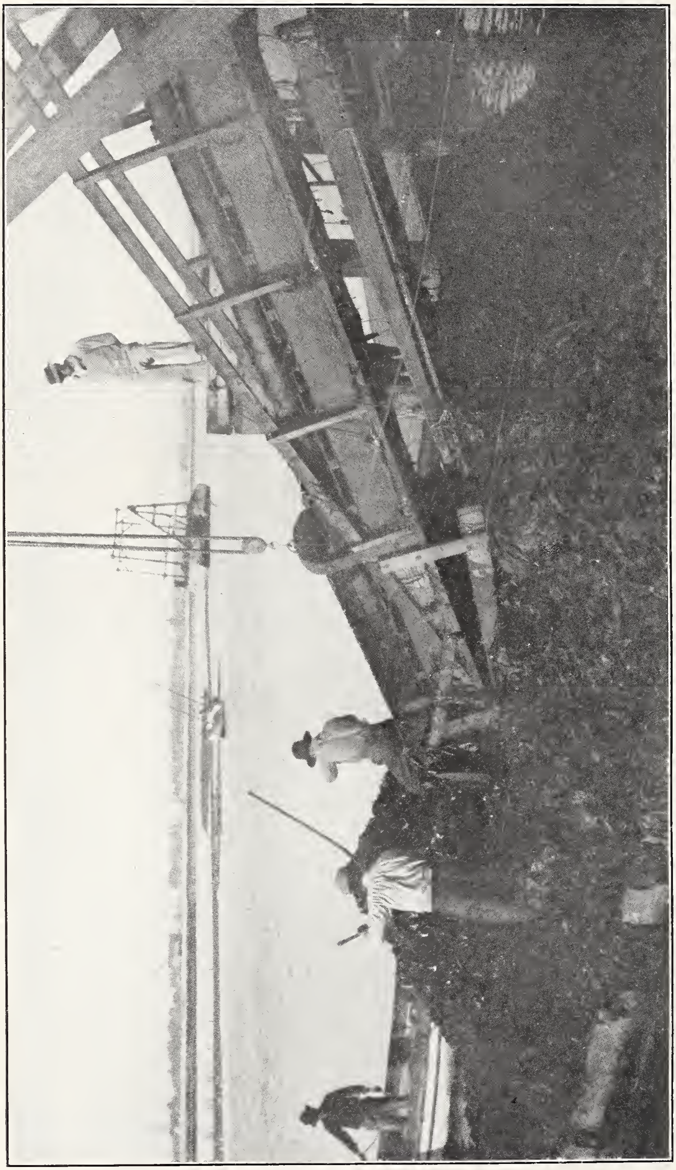
[Photograph by George H. Ennis.]

KELP FALLING FROM CONVEYOR ONTO LOADING BARGE.

[Photograph by George H. Ennis.]

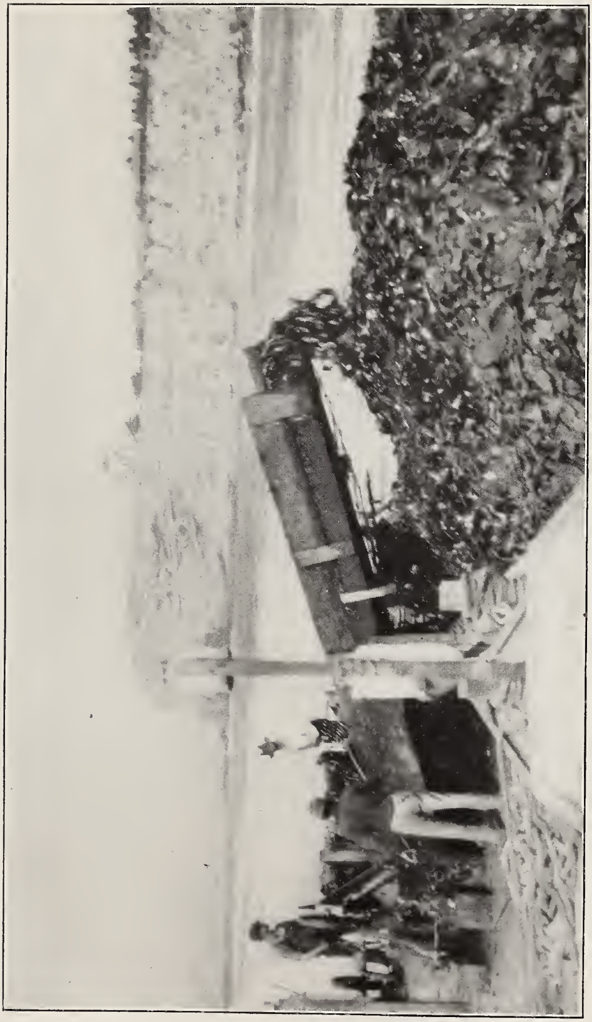
LOAD OF CUT KELP.

[Photograph by George H. Ennis.]



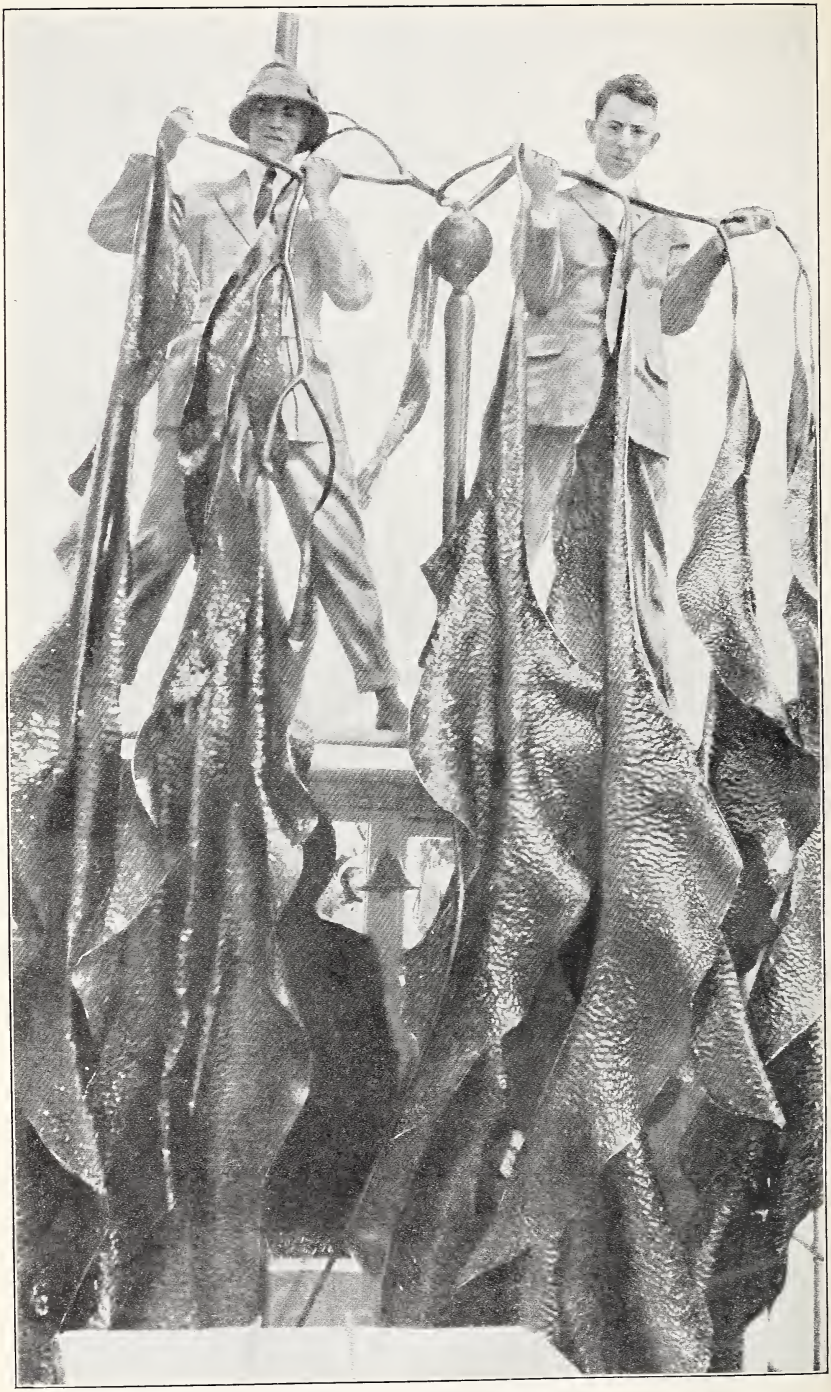
UNLOADING FRESHLY HARVESTED KELP AT SAN PEDRO, CAL.

[Photograph by George H. Ennis.]



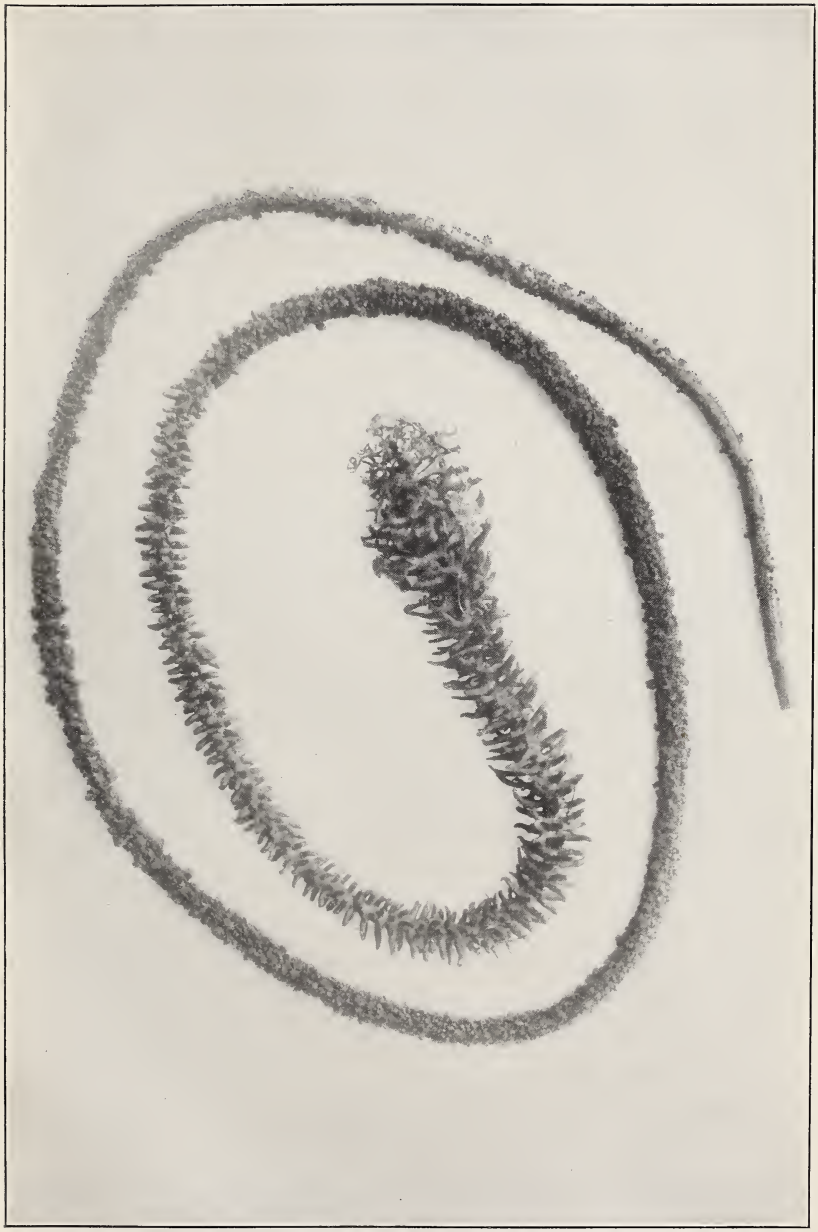
KELP HARVESTER AT WORK.

[Cutter between men leaning over. Engine just behind man on left. Photograph by courtesy of Pacific Kelp Mulch Co.]



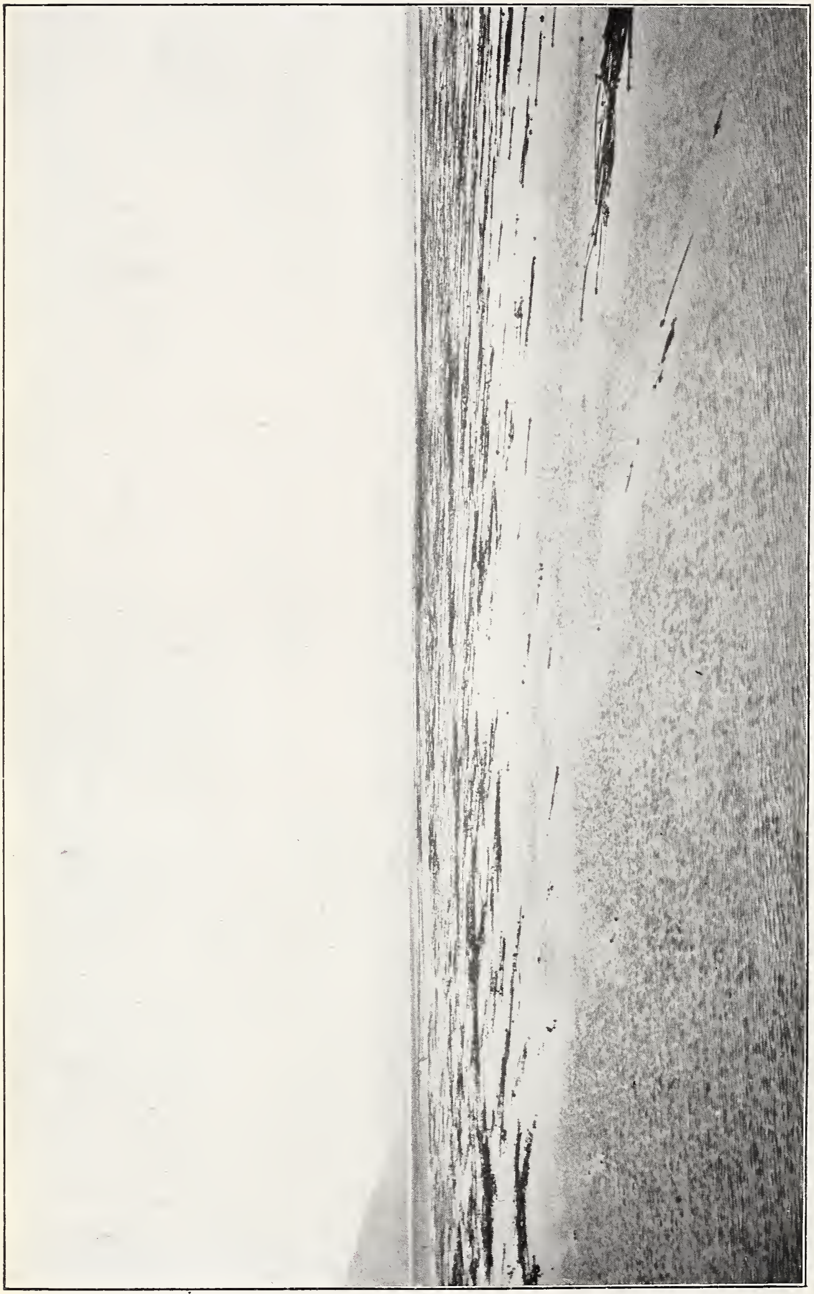
PELAGOPHYCUS PORRA, OR ELK KELP.

[Photograph by courtesy of American Potash Co.]



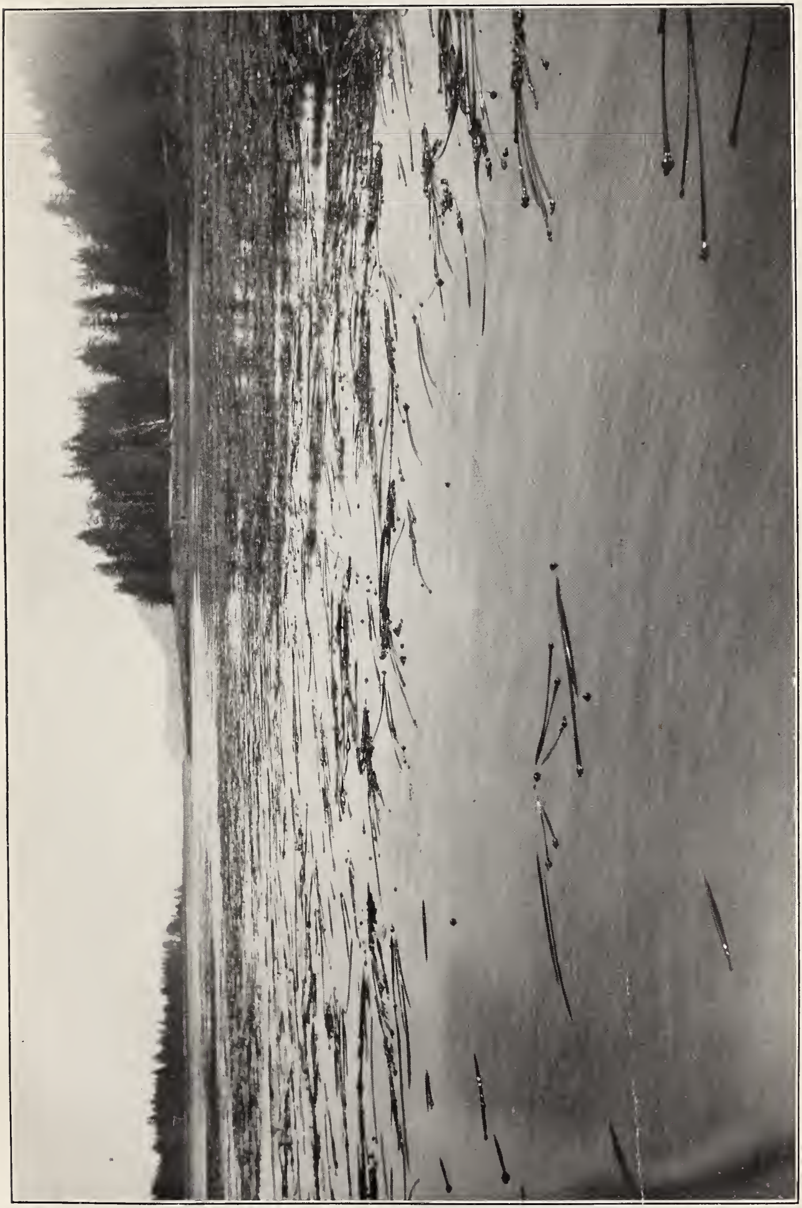
HOLDFAST OF UNATTACHED NEREOCYSTIS, SHOWING CONTINUED GROWTH.

[Photograph by D. Waynick.]



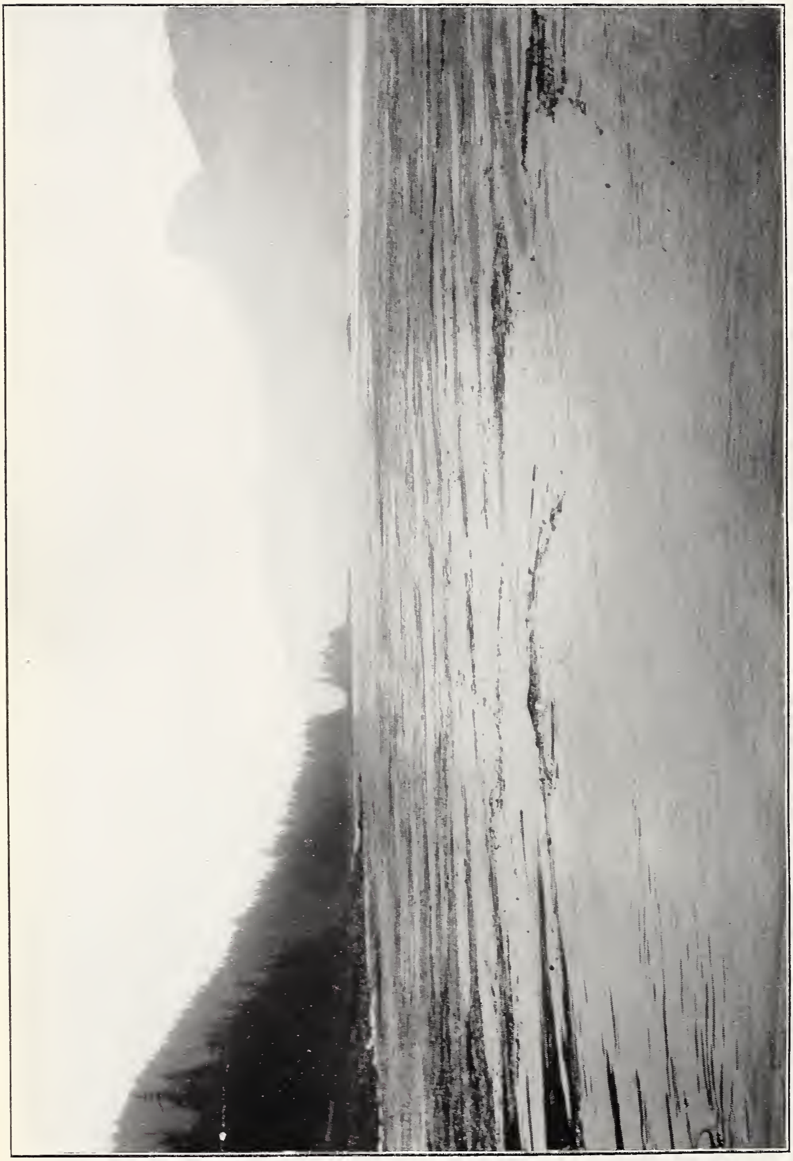
LARGE BED OF NEREOCYSTIS NEAR SHAKAN BAY.

[Photograph by D. Waynick.]



NEREOCYSTIS NEAR BARRIER ISLAND, IN THE NEIGHBORHOOD OF SHAKAN BAY.

[Photograph by D. Waynick.]

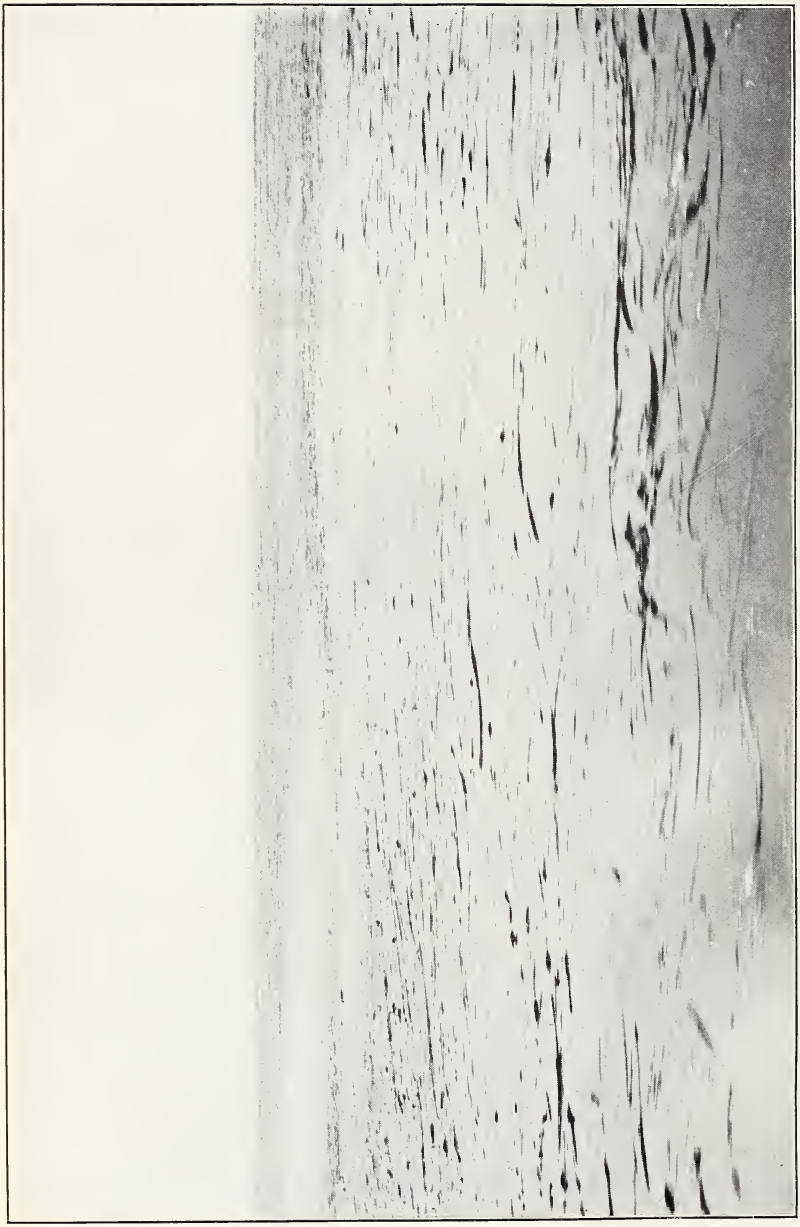


HEAVY BED OF KELP NEAR SHIPLEY BAY.

[Nereocystis outside; Alaria inshore. Photograph by D. Waynick.]

KELP BED NEAR TYEE, ALASKA.

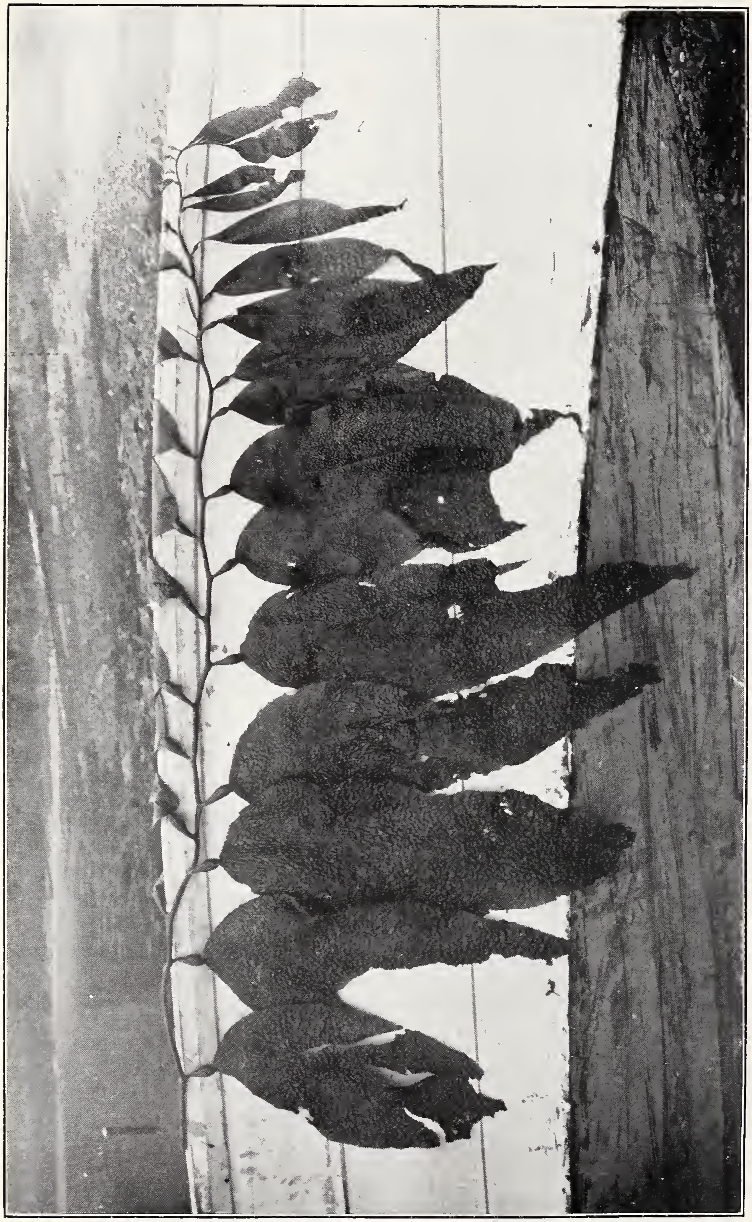
[Alaria close inshore; Nereocystis outside. Photograph by D. Waynick.]



EXTENSIVE MIXED BED OF ALARIA AND NEREOCYSTIS, NEAR POINT GARDNER.

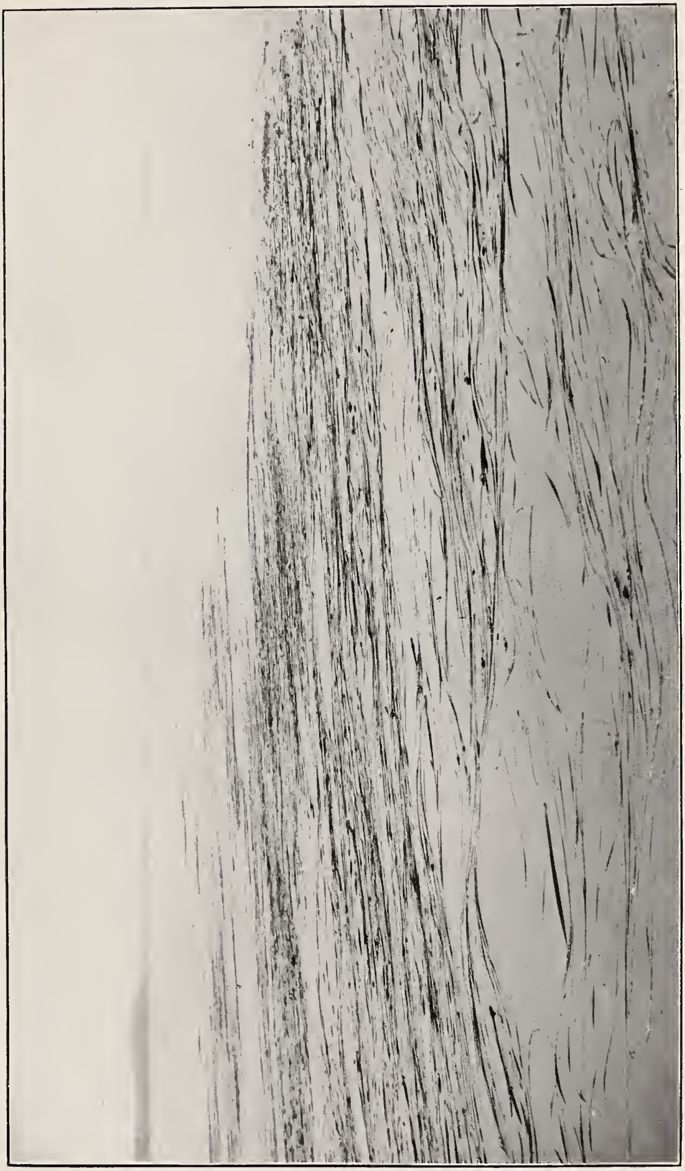
[Photograph by D. Waynick.]

FROND OF MACROCYSTIS PYRIFERA, OR LONG BLADDER KELP.
[Photograph by D. Waynick.]



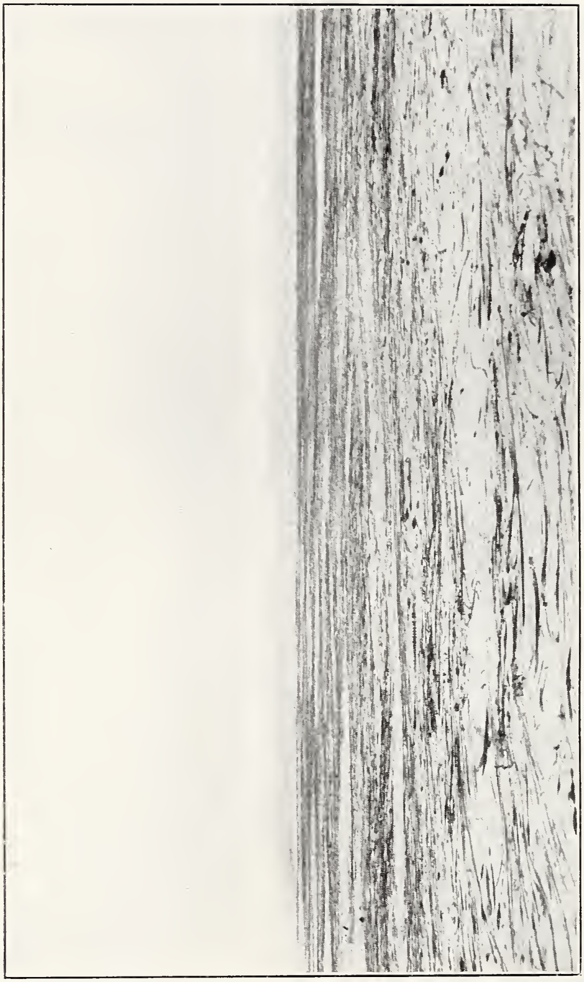
SHOWING MANNER OF FORMATION OF LEAVES OF MACROCYSTIS.

[Photograph by D. Waynick.]



USUAL APPEARANCE OF BED OF ALARIA IN SUMNER STRAIT.

[Photograph by D. Waynick.]



HEAVY BED OF ALARIA, GEESE ISLANDS.

[Photograph by Robert F. Griggs.]

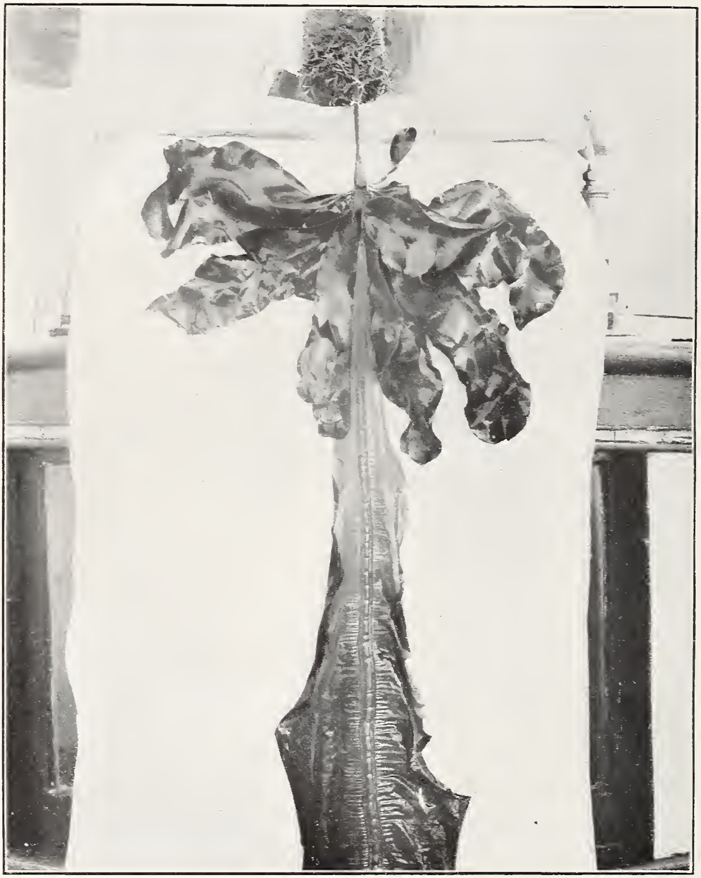
A WIDE SHORE FRINGE OF ALARIA IN KEKU INLET.

ALARIA FISTULOSA: GENERAL APPEARANCE OF A WIDE-LEAFED PLANT.

[Photograph by S. M. Zeller.]

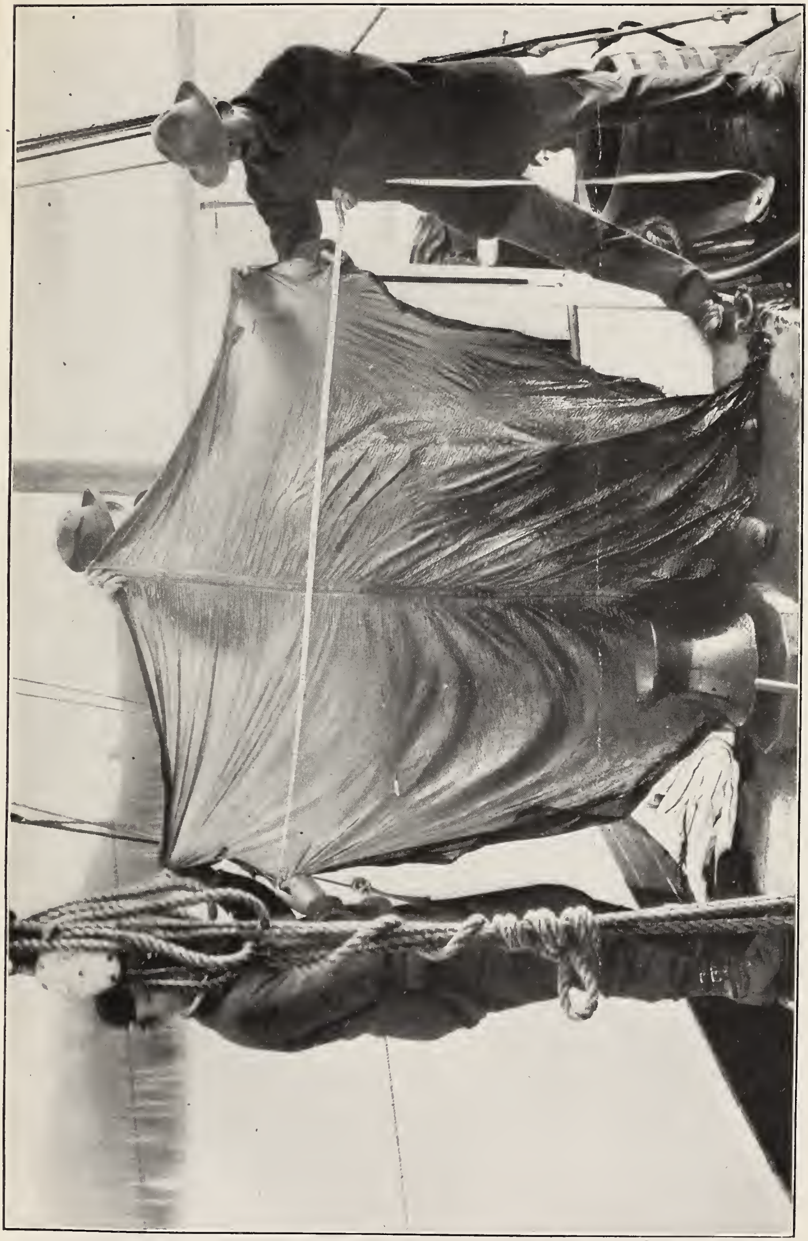
SPORE LEAVES OF ALARIA FISTULOSA.

[There were about 220 on this plant. Photograph by S. M. Zeller.]



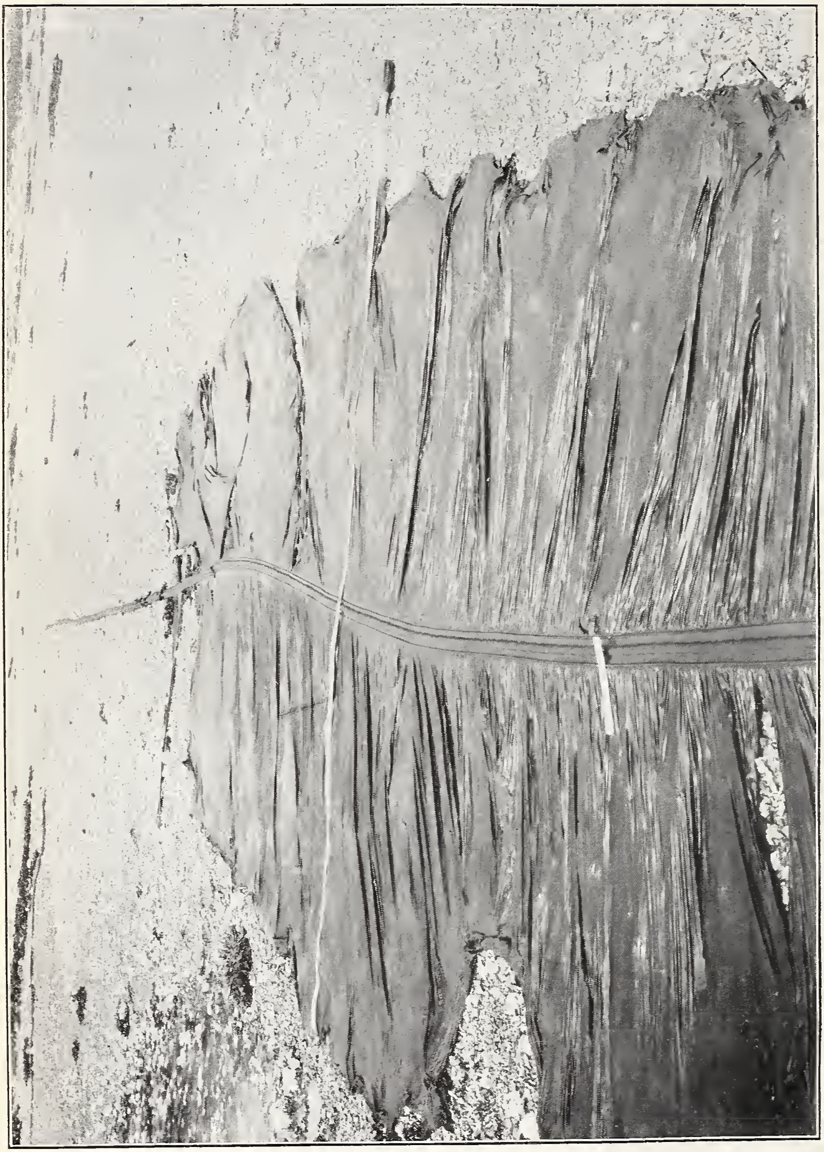
ALARIA FISTULOSA.

[Light portion of large leaf is growing area; small leaves are reproducing leaves only. Photograph by S. M. Zeller.]



ALARIA FISTULOSA, SHOWING LAMINA 5 FEET 10 INCHES BROAD.

[Photograph by S. M. Zeller.]



AN ALARIA FISTULOSA FROND MEASURING 7 FEET 9 INCHES IN WIDTH.

[This photograph shows also the common fraying of tip. Photograph by S. M. Zeller.]

FUCUS (ROCKWEED).
[Photograph by S. M. Zeller.]

DRIFT OF FUCUS AND OTHER ALGÆ.

[This resembles at first glance bed of growing kelp. Photograph by D. Waynick.]

U. S. DEPT OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY, CHIEF

INDEX MAP

KELP GROVES
OF THE PACIFIC COAST AND ISLANDS

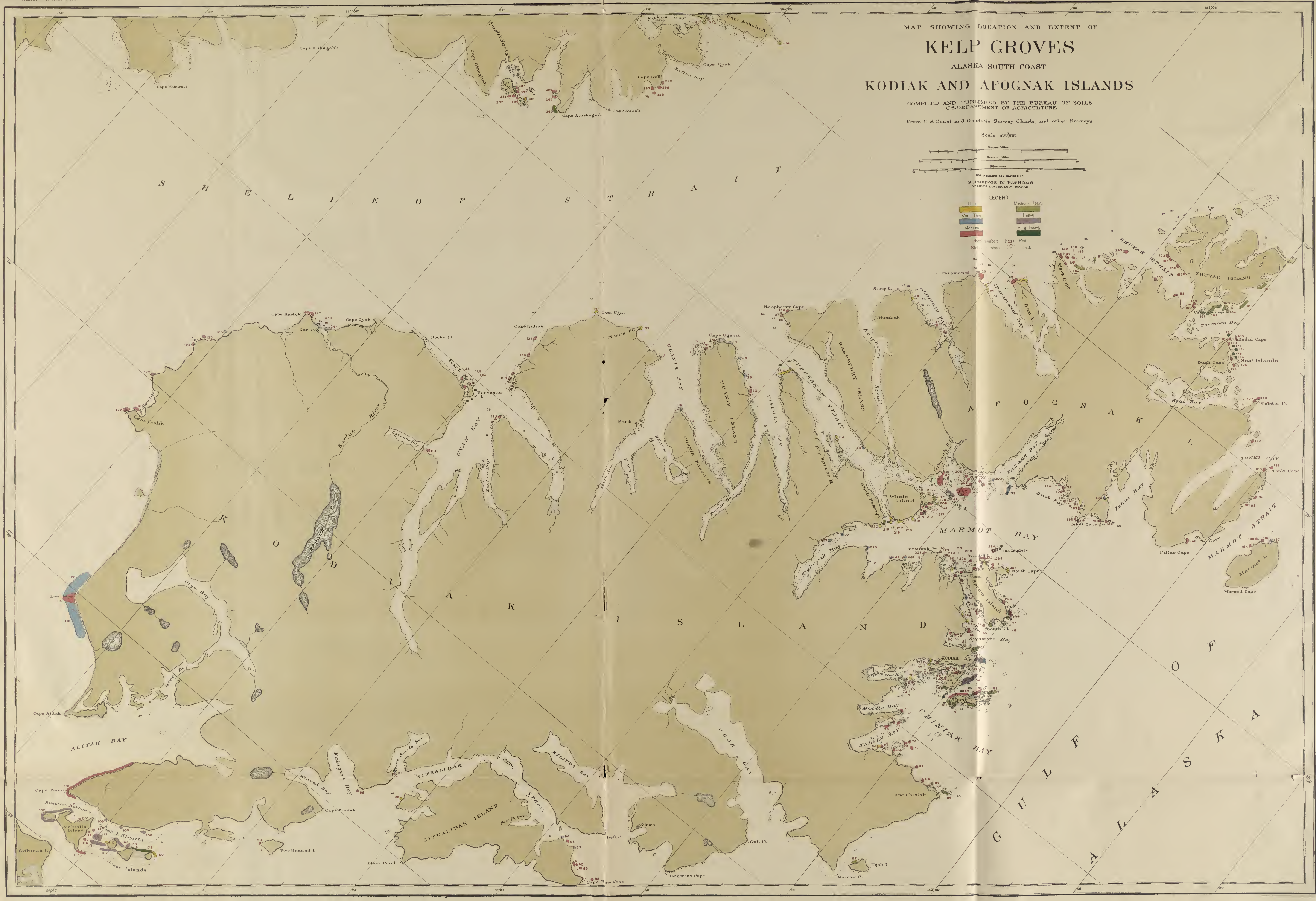
FERTILIZER INVESTIGATIONS
FRANK K. CAMERON, in charge

OFFICE OF THE SECRETARY—REPORT NO 100

U S DEPT OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY, CHIEF

KELP MAP

PACIFIC COAST - ALASKA



FERTILIZER INVESTIGATIONS
FRANK K. CAMERON in charge
Mapped by Geo B. Rigg
1913

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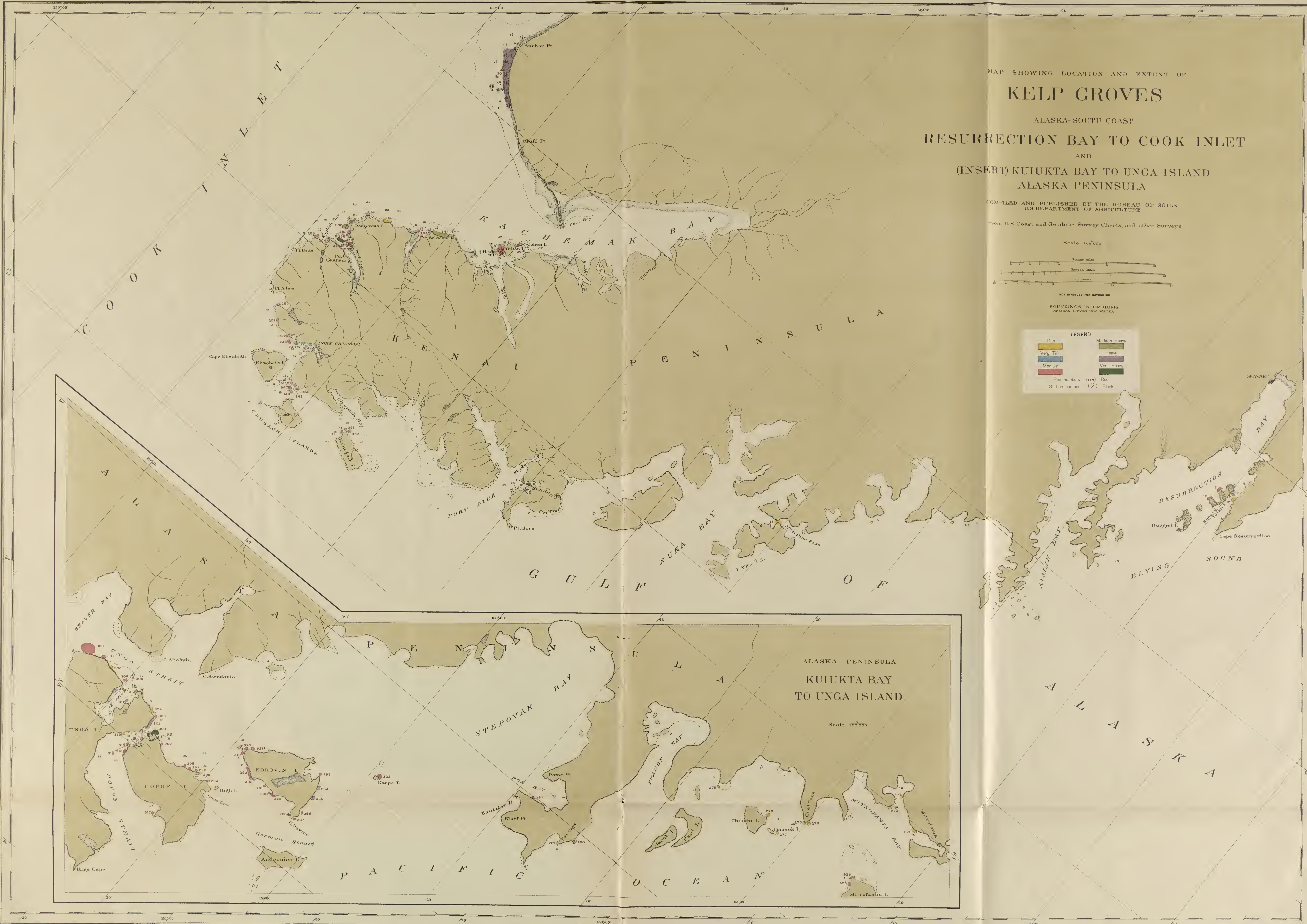
BUREAU OF SOILS
MILTON WHITNEY, CHIEF

KELP MAP

PACIFIC COAST - ALASKA

SHEET B



FERTILIZER INVESTIGATIONS
FRANK K. CAMERON in charge
Mapped by Geo. B. Rigg
913

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BUREAU OF SOILS
MILTON WHITNEY, CHIEF

KELP MAP

PACIFIC COAST—ALASKA

SHEET C

KELP MAP


SHEET D
MAP SHOWING
LOCATION AND EXTENT OF
KELP GROVES
SOUTHEAST ALASKA
CHATHAM STRAIT
AND BARANOF ISLAND
Published at Washington D.C.
1914
BY THE U. S. DEPARTMENT OF AGRICULTURE
BUREAU OF SOILS
Base reproduced from
COAST AND GEODETIC SURVEY CHART 8250
Compiled from surveys between 1889 and 1906
and other sources
SOUNDINGS IN FATHOMS
Statute Miles
Nautical Miles
Kilometers
Not intended for navigation
LEGEND
Thin
Very Thin
Medium
Medium Heavy
Heavy
Very Heavy
Bed numbers (123) Red
Station numbers (2) Black
CHICHAGOF I.
BARANOF ISLAND
CHATHAM STRAIT
ADMIRALTY I.
KUIU I.
KRUZOF I.
YAKOBI I.
PACIFIC OCEAN
CAPE OMMANEY
CAPE EDWARD
Sta. 19
Sta. 16

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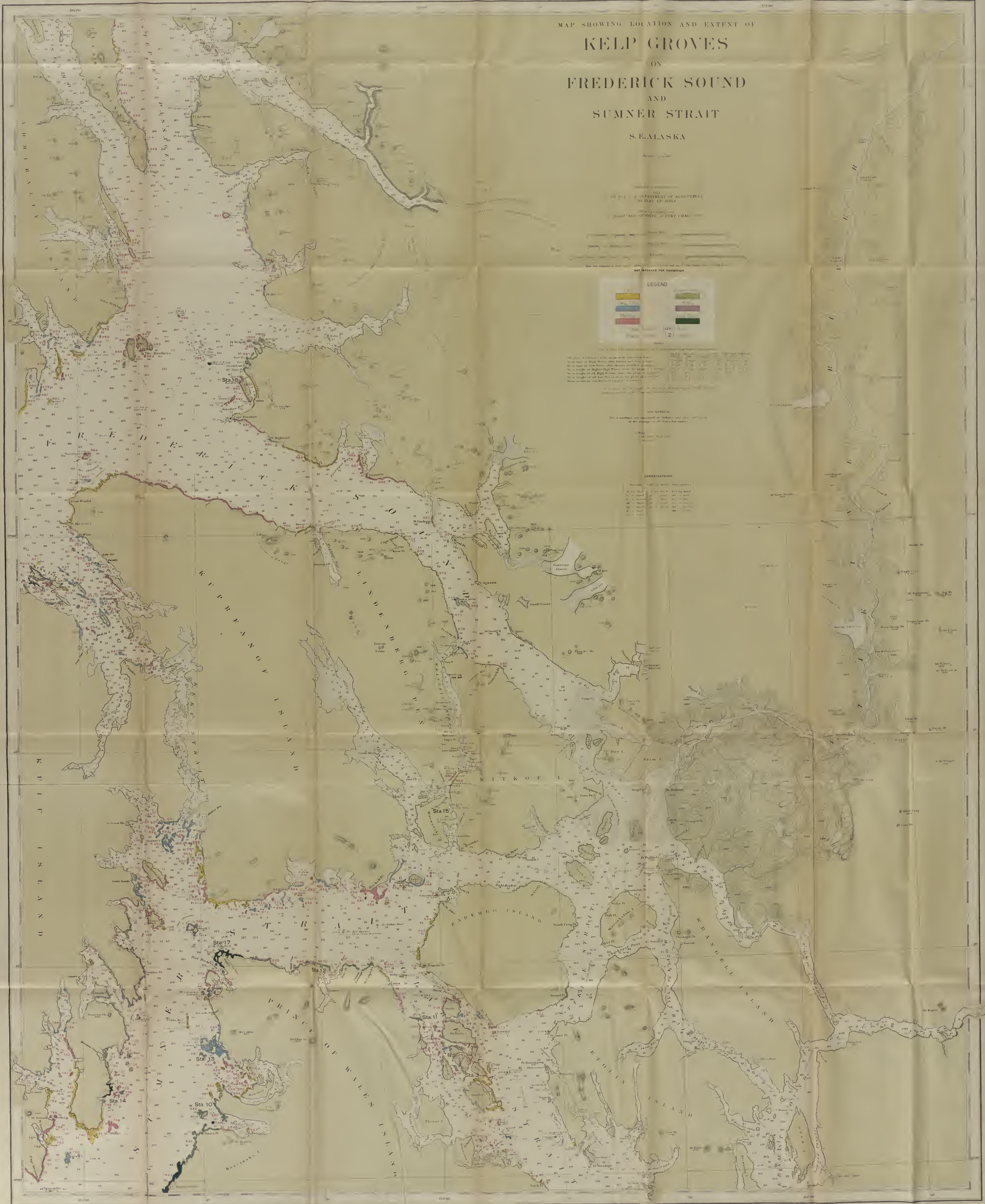
BUREAU OF SOILS
MILTON WHITNEY, CHIEF

KELP MAP

PACIFIC COAST—ALASKA

SHEET 2



FERTILIZER INVESTIGATIONS
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1913

KELP MAP

PACIFIC COAST—ALASKA

SHEET F

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MILTON WHITNEY, CHIEF

FERTILIZER INVESTIGATIONS
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MILTON WHITNEY, CHIEF

KELP MAP

PACIFIC COAST–ALASKA

SHEET G

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1913

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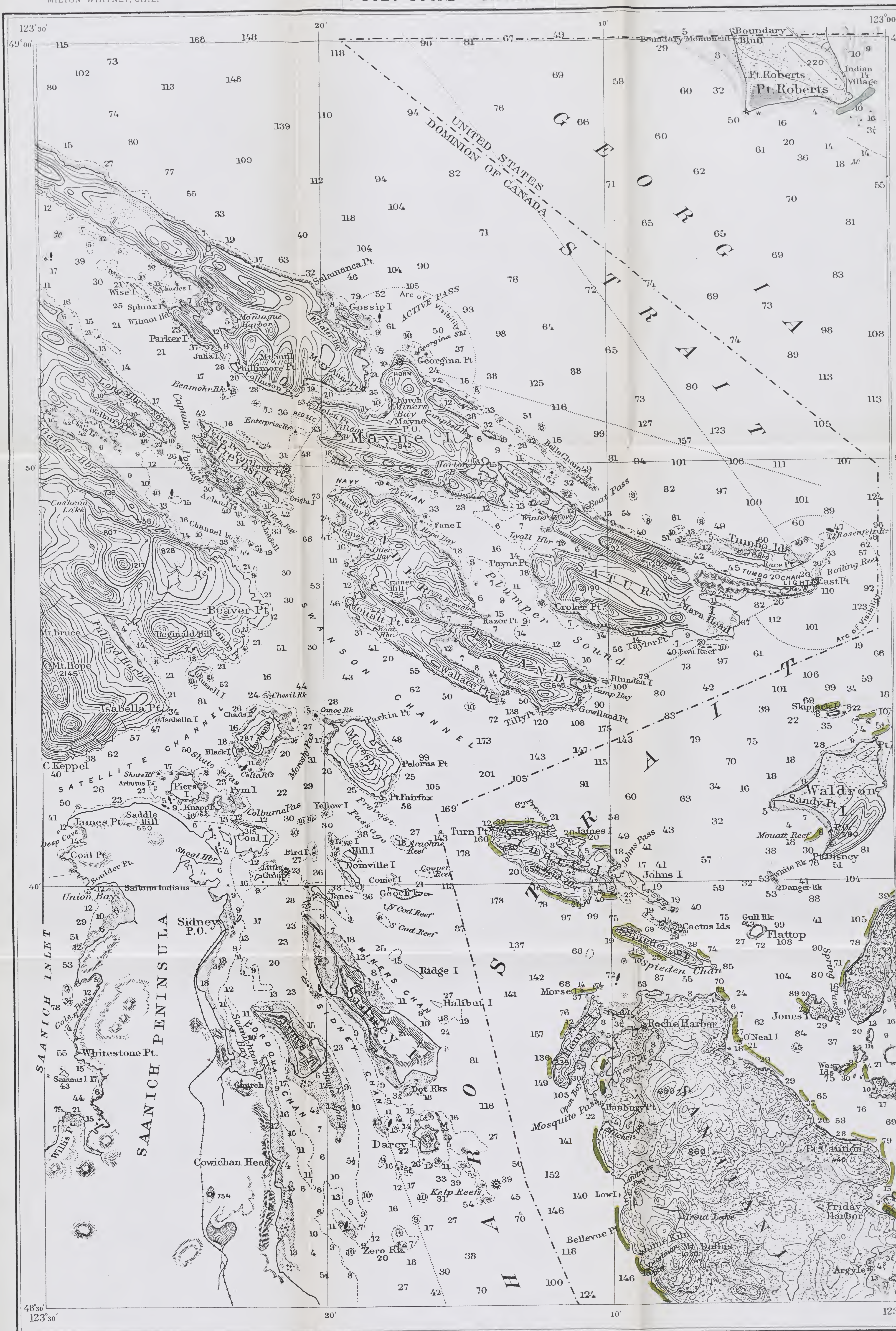
BUREAU OF SOILS
MILTON WHITNEY, CHIEF

KELP MAP
PUGET SOUND - WASHINGTON

SHEET NO. 1



FERTILIZER INVESTIGATIONS.
FRANK K. CAMERON in charge.
Mapped by Geo. B. Rigg.
1912

BASE MAP FROM COAST AND GEODETIC SURVEY CHART NO. 6300

Scale $\frac{1}{100000}$

Statute Miles

Nautical Miles

Kilometers

SOUNDINGS IN FATHOMS EXCEPT ON DOTTED SURFACES WHERE SHOWN IN FEET

NOT INTENDED FOR NAVIGATION

LEGEND

Medium Heavy

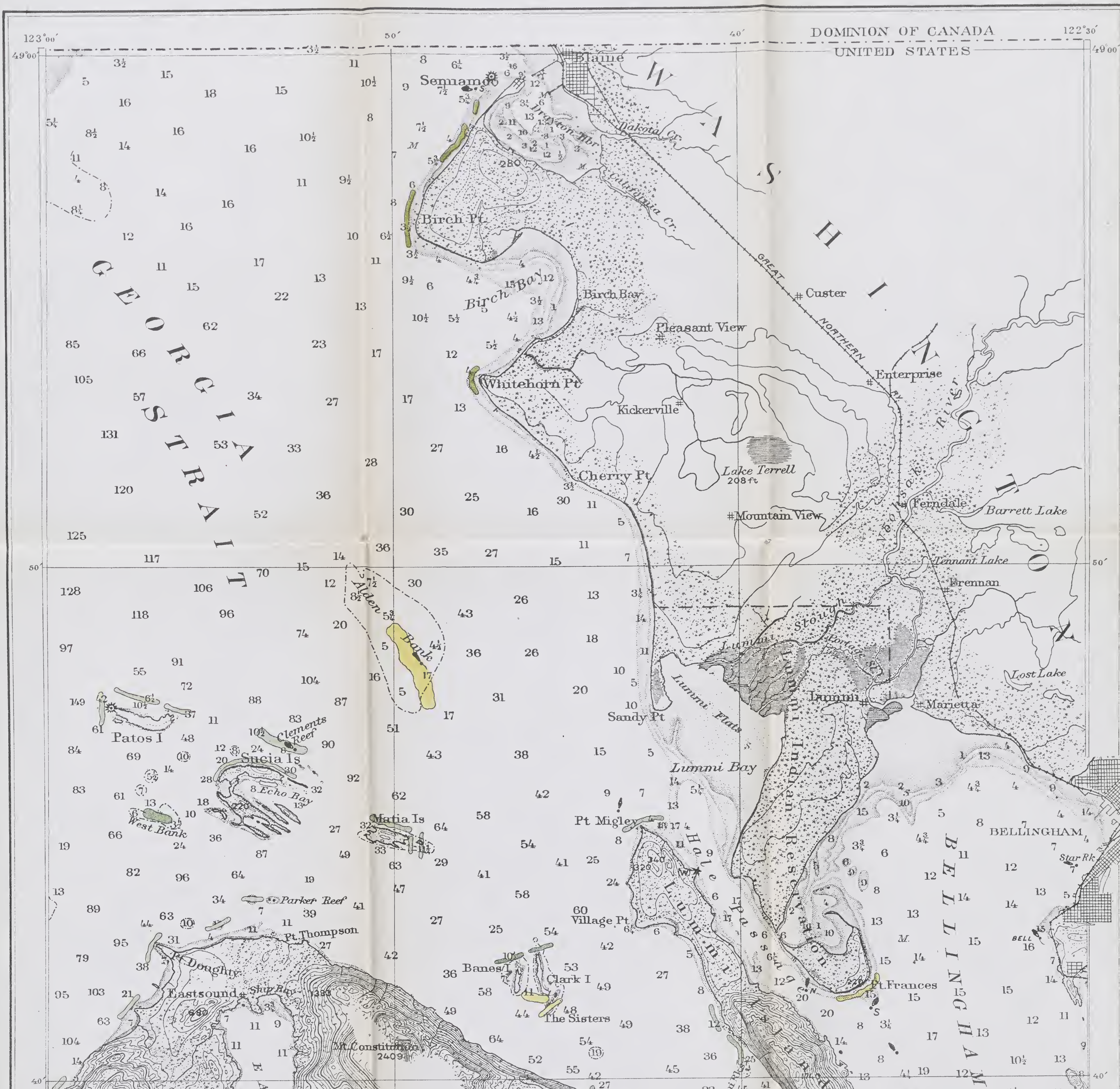
Very Heavy

U. S. DEPT. OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY, CHIEF

KELP MAP

PUGET SOUND - WASHINGTON

SHEET NO. 2



FERTILIZER INVESTIGATIONS.
FRANK K. CAMERON in charge.
Mapped by Geo. B. Rigg
1912

BASE MAP FROM
COAST AND GEODETIC SURVEY
CHART NO. 6300

Scale 1/100000
Statute Miles
Nautical Miles
Kilometers

SOUNDINGS IN FATHOMS
EXCEPT ON DOTTED SURFACES
WHERE SHOWN IN FEET

NOT INTENDED FOR NAVIGATION

LEGEND

Thin
Medium Heavy
Very Heavy

OFFICE OF THE SECRETARY. REPORT NO. 100

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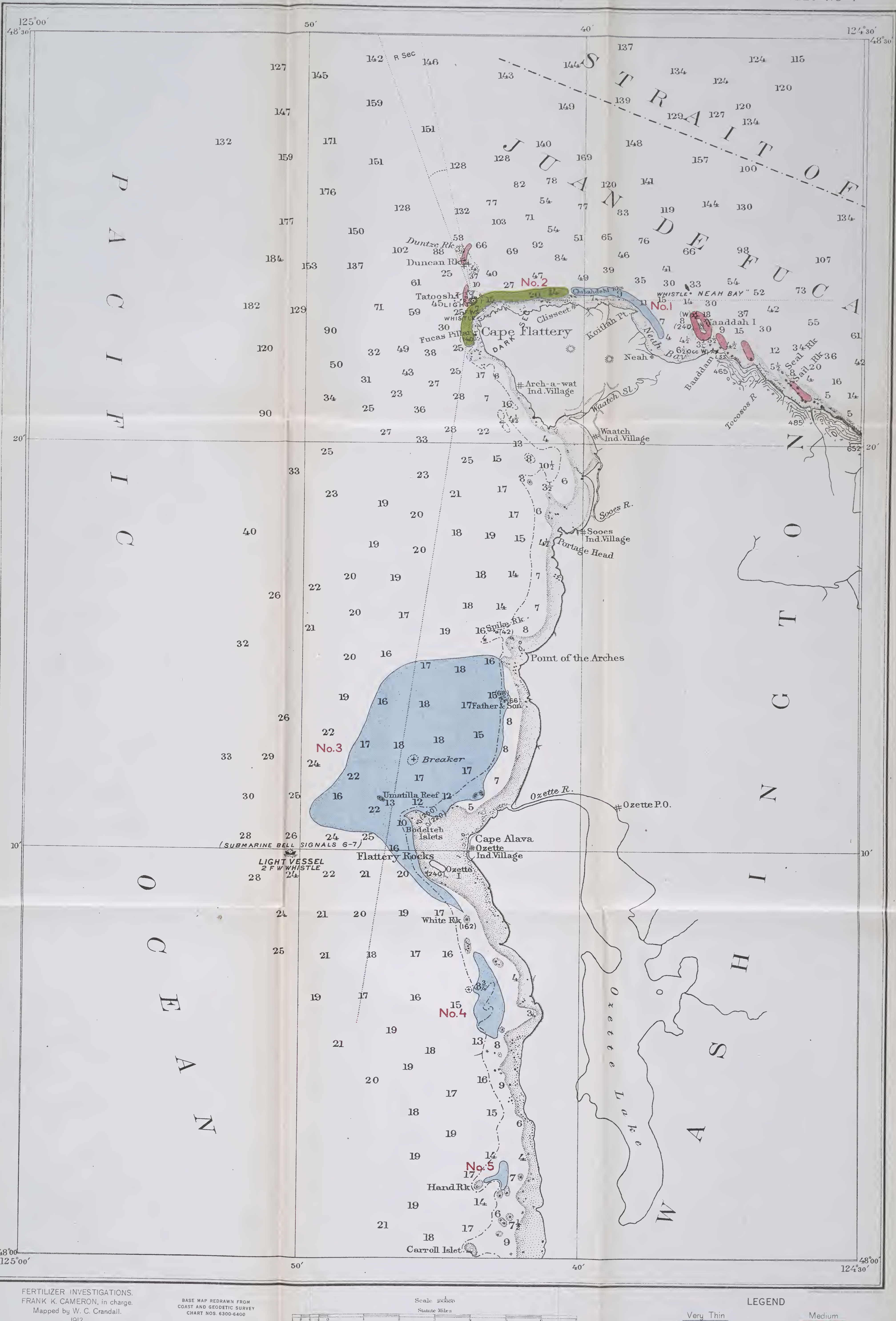
BUREAU OF SOILS
MILTON WHITNEY CHIEF

KELP MAP
PACIFIC COAST - WASHINGTON

SHEET NO 4



FERTILIZER INVESTIGATIONS.
FRANK K. CAMERON, in charge.
Mapped by W. C. Crandall.
1912

BASE MAP REDRAWN FROM
COAST AND GEODETIC SURVEY
CHART NOS. 6300-6400

Scale 1/200000
Statute Miles
Nautical Miles
Kilometers

SOUNDINGS IN FATHOMS
HEIGHTS IN FEET

NOT INTENDED FOR NAVIGATION

LEGEND
Very Thin
Medium
Very Heavy

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BUREAU OF SOILS
MILTON WHITNEY, CHIEF

KELP MAP
PUGET SOUND - WASHINGTON

SHEET NO. 5

FERTILIZER INVESTIGATIONS
FRANK K. CAMERON in charge
Mapped by Geo. B. Rigg
1912

BASE MAP FROM
COAST AND GEODETIC SURVEY
CHART NOS. 6300-6400

Scale 1/100000
Statute Miles
Nautical Miles
Kilometers

SOUNDINGS IN FATHOMS
HEIGHTS IN FEET

NOT INTENDED FOR NAVIGATION

LEGEND

Very Thin
Medium
Heavy

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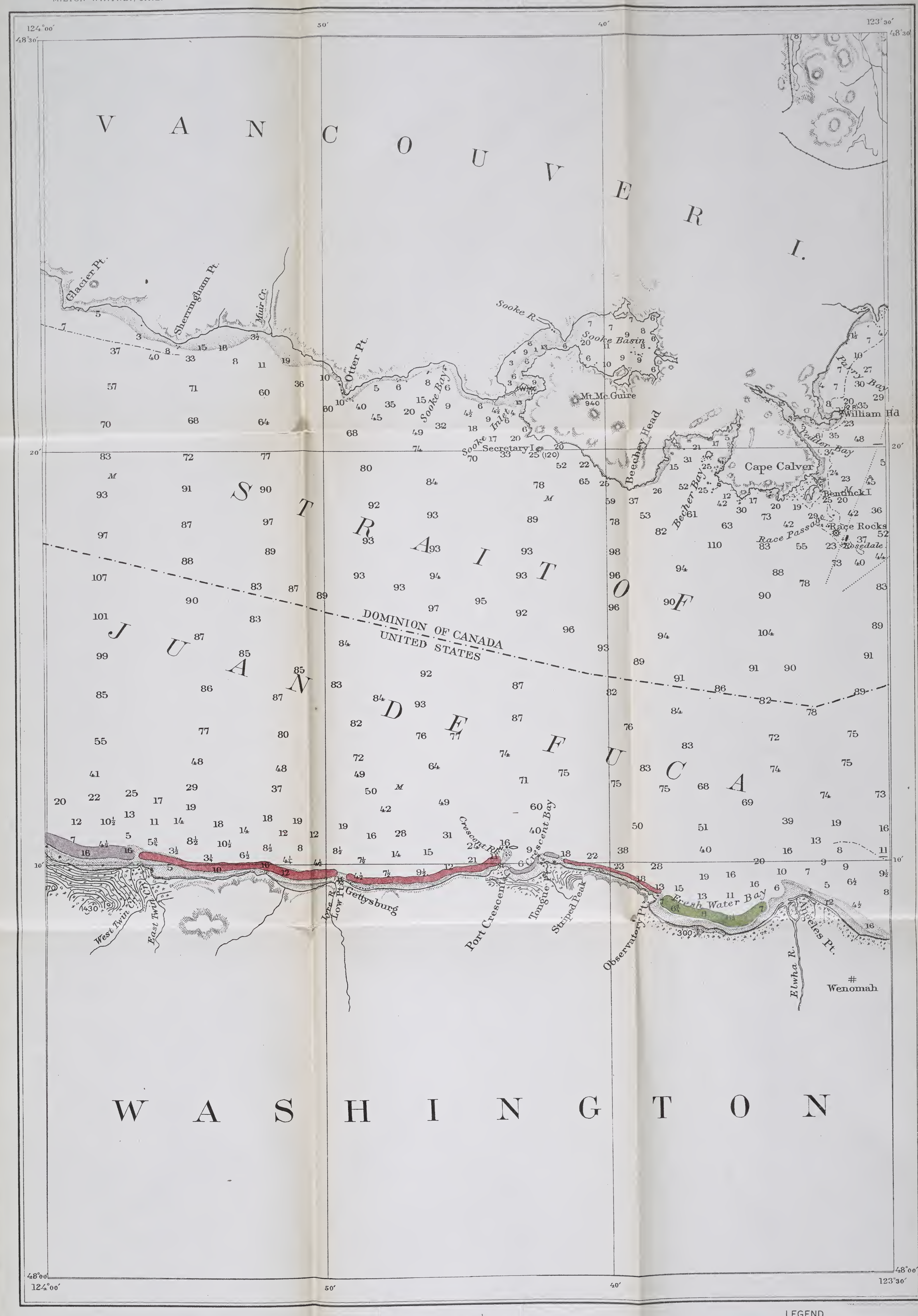
U. S. DEPT OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY, CHIEF

KELP MAP

PUGET SOUND - WASHINGTON



FERTILIZER INVESTIGATIONS,
FRANK K. CAMERON in charge.
Mapped by Geo. B. Rigg.
1912

BASE MAP FROM
COAST AND GEODETIC SURVEY
CHART NOS. 6300-6400

Scale 1/80000
Statute Miles
Nautical Miles
Kilometers

SOUNDINGS IN FATHOMS
EXCEPT ON DOTTED SURFACES
WHERE SHOWN IN FEET

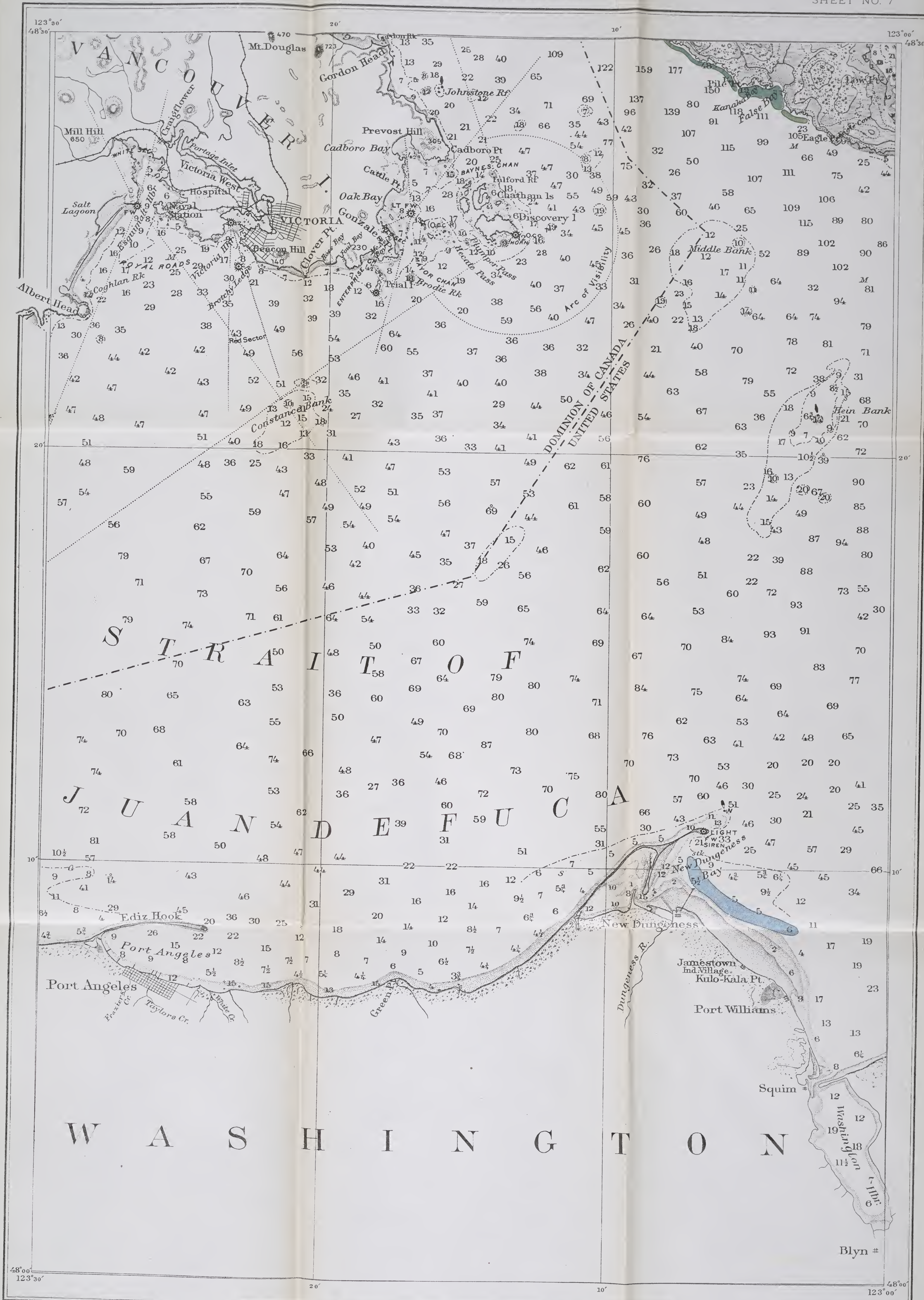
NOT INTENDED FOR NAVIGATION

U. S. DEPT. OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY, CHIEF

KELP MAP

PUGET SOUND - WASHINGTON

SHEET NO. 7



FERTILIZER INVESTIGATIONS,
FRANK K. CAMERON in charge
Mapped by Geo. B. Rigg
1912

BASE MAP FROM
COAST AND GEODETIC SURVEY
CHART NOS. 6300-6400

Scale 1/200000
Statute Miles
Nautical Miles
Kilometers

SOUNDINGS IN FATHOMS
EXCEPT ON DOTTED SURFACES
WHERE SHOWN IN FEET

NOT INTENDED FOR NAVIGATION

LEGEND

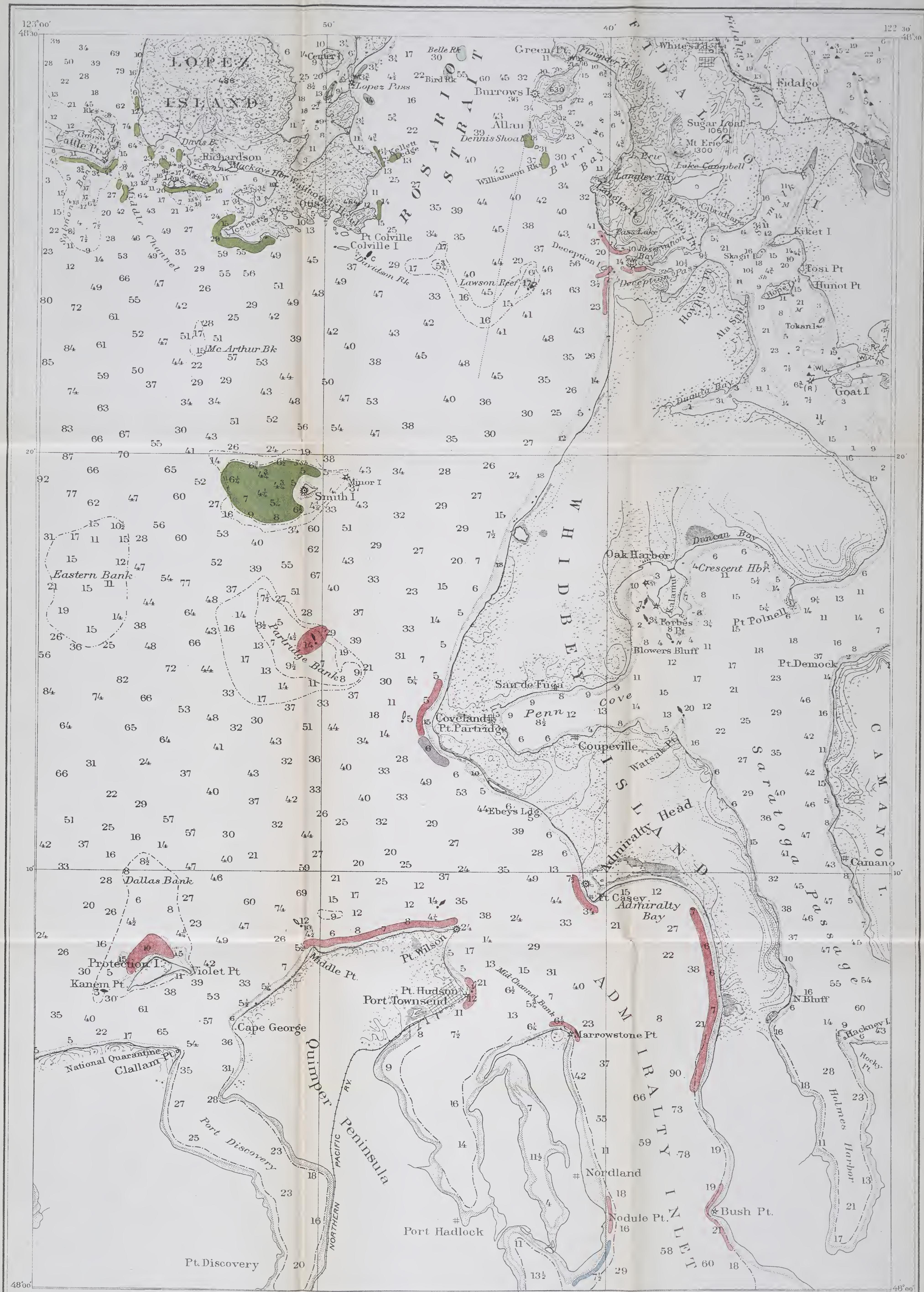
Very Thin
Very Heavy

OFFICE OF THE SECRETARY REPORT NO. 100

U. S. DEPT OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY, CHIEF

KELP MAP

PUGET SOUND - WASHINGTON



FERTILIZER INVESTIGATIONS.
FRANK K. CAMERON in charge.
Mapped by Geo. B. Rigg
1912

BASE MAP FROM
COAST AND GEODETIC SURVEY
CHART NOS. 6300-6400

SOUNDINGS IN FATHOMS
EXCEPT ON DOTTED SURFACES
WHERE SHOWN IN FEET

NOT INTENDED FOR NAVIGATION

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BUREAU OF SOILS
MILTON WHITNEY, CHIEF

KELP MAP

PUGET SOUND - WASHINGTON

SHEET NO. 11

FERTILIZER INVESTIGATIONS.
FRANK K. CAMERON in charge.
Mapped by Geo. B. Rigg
1912

BASE MAP REDRAWN FROM COAST AND GEODETIC SURVEY CHART NO. 6400

Scale $\frac{1}{100000}$

Statute Miles

Nautical Miles

Kilometers

SOUNDINGS IN FATHOMS
HEIGHTS IN FEET

NOT INTENDED FOR NAVIGATION

LEGEND

Very Thin

Medium

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U. S. DEPT. OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY, CHIEF

KELP MAP

PUGET SOUND - WASHINGTON

SHEET NO. 14

FERTILIZER INVESTIGATIONS,
FRANK K. CAMERON in charge.
Mapped by Geo. B. Rigg.
1912

BASE MAP REDRAWN FROM
COAST AND GEODETIC SURVEY
CHART NO. 6400

Scale $\frac{1}{200000}$

Statute Miles

Nautical Miles

Kilometers

SOUNDINGS IN FATHOMS
HEIGHTS IN FEET

NOT INTENDED FOR NAVIGATION

LEGEND

Very Thin

Medium

Heavy

U. S. DEPT. OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY, CHIEF

KELP MAP

PACIFIC COAST - OREGON

SHEET NO. 20

FERTILIZER INVESTIGATIONS.
FRANK K. CAMERON, in charge.
Mapped by W. C. Crandall.
1912

BASE MAP FROM
COAST AND GEODETIC SURVEY
CHART NO. 6000

Scale $\frac{1}{100000}$
Statute Miles
Nautical Miles
Kilometers

SOUNDINGS IN FATHOMS
EXCEPT ON DOTTED SURFACES
WHERE SHOWN IN FEET

NOT INTENDED FOR NAVIGATION

LEGEND

Thin

Reported

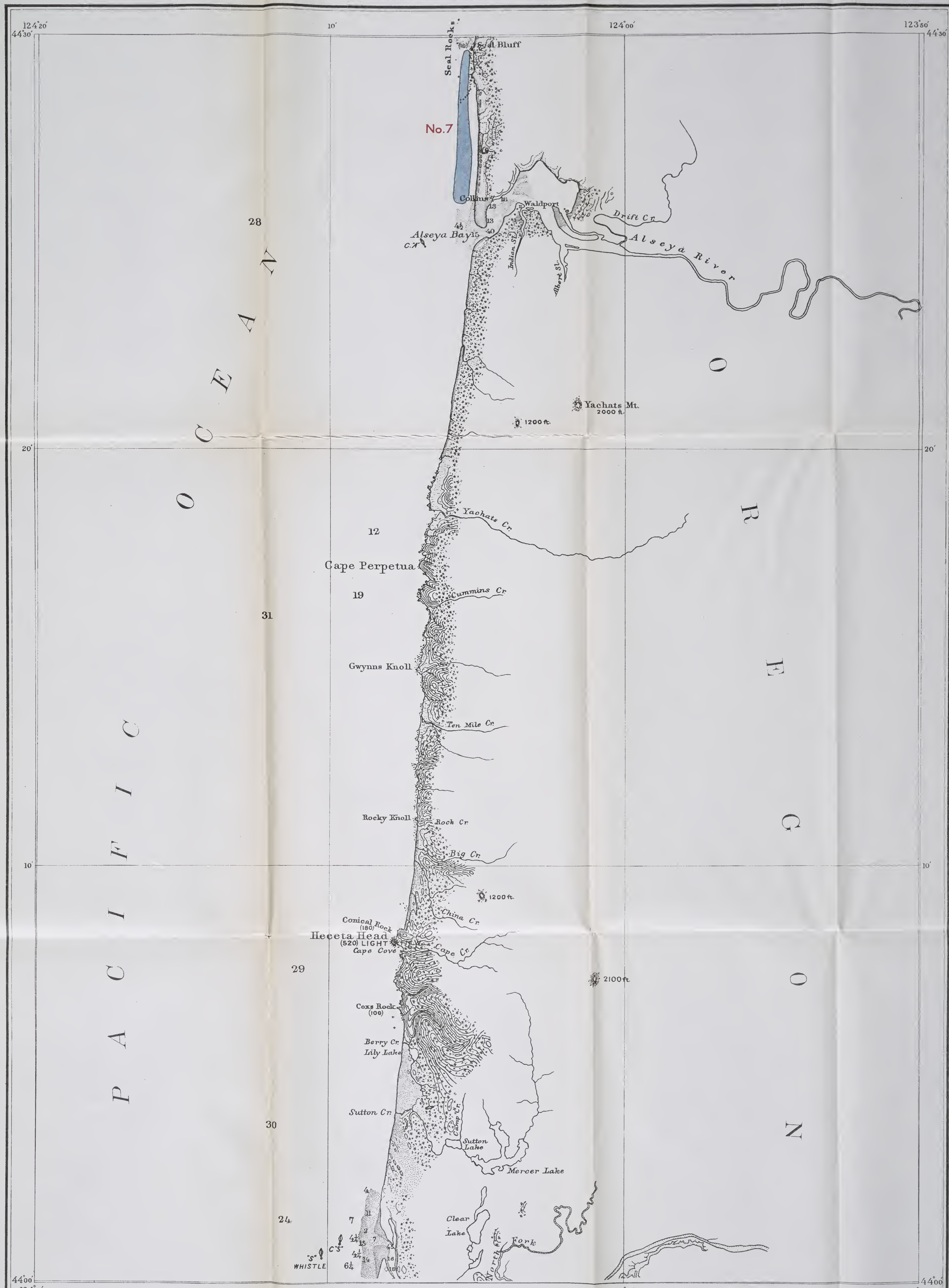
OFFICE OF THE SECRETARY REPORT NO 100

U. S. DEPT. OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY, CHIEF

KELP MAP

PACIFIC COAST - OREGON

SHEET NO. 21



FERTILIZER INVESTIGATIONS.
FRANK K. CAMERON, in charge.
Mapped by W. C. Crandall.
1912

BASE MAP FROM
COAST AND GEODETIC SURVEY
CHART NO. 6000

Scale $\frac{1}{200000}$
Statute Miles
Nautical Miles
Kilometers

SOUNDINGS IN FATHOMS
EXCEPT ON DOTTED SURFACES
WHERE SHOWN IN FEET

NOT INTENDED FOR NAVIGATION

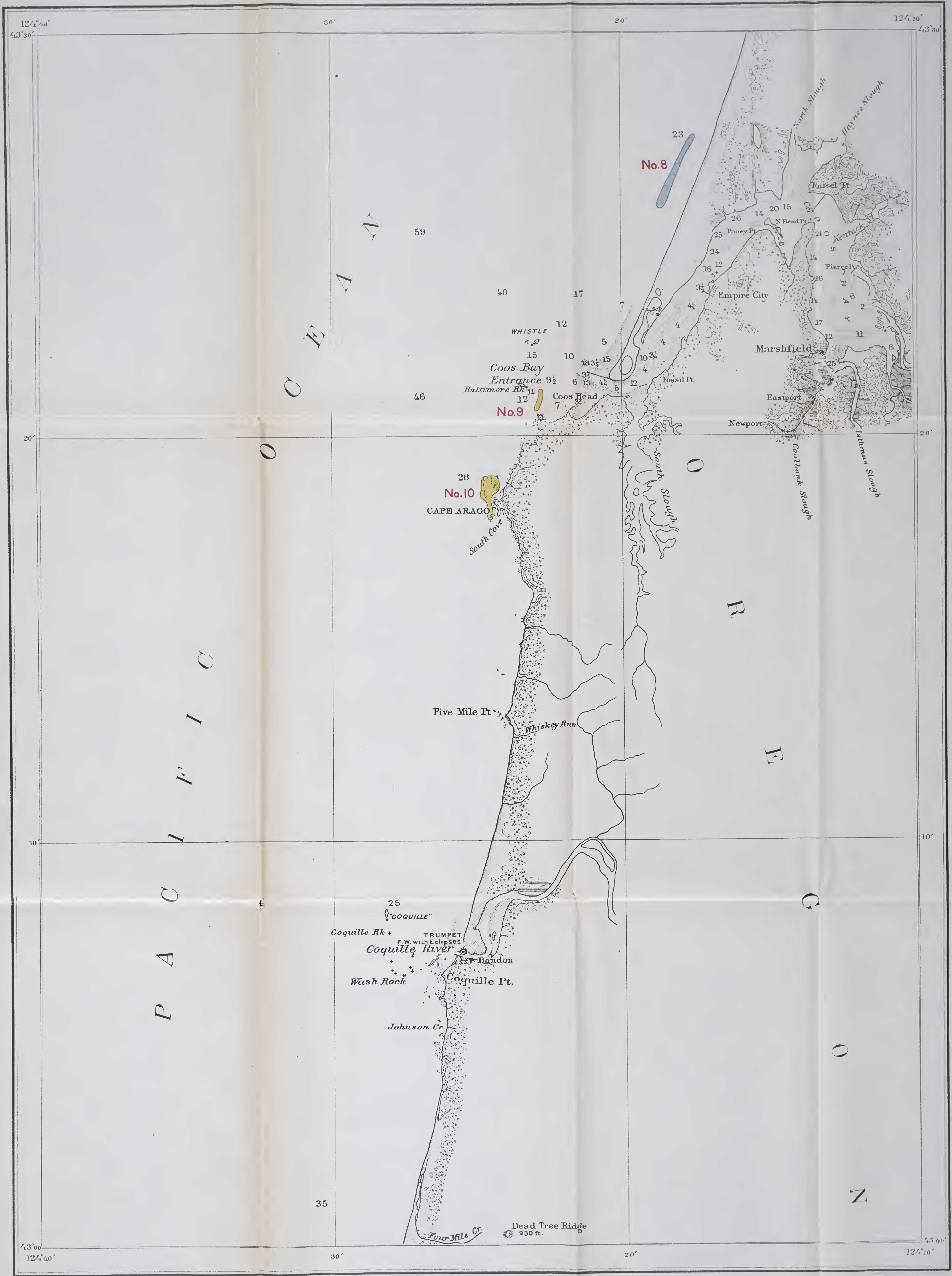
LEGEND
Very Thin
Reported

OFFICE OF THE SECRETARY REPORT NO. 100

U. S. DEPT. OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY, CHIEF

KELP MAP
PACIFIC COAST - OREGON

SHEET NO. 23



FERTILIZER INVESTIGATIONS
FRANK K. CAMERON, in charge
Mapped by W. C. Crandall
1912

BASE MAP FROM
COAST AND GEODETIC SURVEY
CHART NO. 5900

Scale 1/80000
Statute Miles
Nautical Miles
Kilometers

SOUNDINGS IN FATHOMS
EXCEPT ON DOTTED SURFACES
WHERE SHOWN IN FEET

NOT INTENDED FOR NAVIGATION

LEGEND
Thin
Very Thin

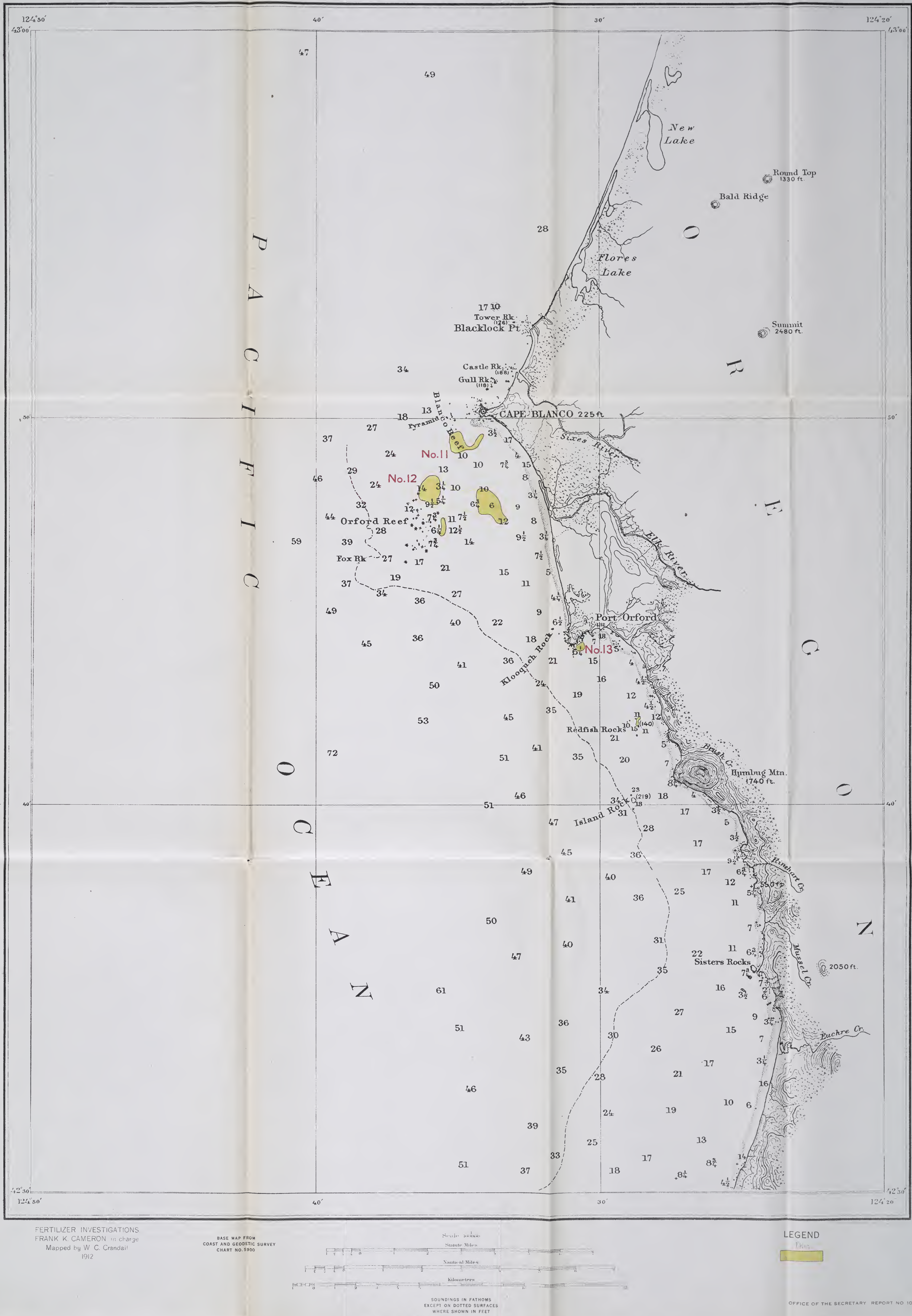
OFFICE OF THE SECRETARY - REPORT NO. 100

U. S. DEPT. OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY, CHIEF

KELP MAP

PACIFIC COAST - OREGON

SHEET NO. 24



FERTILIZER INVESTIGATIONS
FRANK K. CAMERON in charge
Mapped by W. C. Crandall
1912

BASE MAP FROM
COAST AND GEODETIC SURVEY
CHART NO. 5900

SOUNDINGS IN FATHOMS
EXCEPT ON DOTTED SURFACES
WHERE SHOWN IN FEET

NOT INTENDED FOR NAVIGATION

LEGEND

Kelp

OFFICE OF THE SECRETARY REPORT NO. 100

U. S. DEPT. OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY, CHIEF

KELP MAP

PACIFIC COAST - OREGON

SHEET NO. 25

FERTILIZER INVESTIGATIONS
FRANK K. CAMERON, in charge
Mapped by W. C. Crandall
1912

BASE MAP FROM
COAST AND GEODETIC SURVEY
CHART NO. 5900

Scale $\frac{1}{100000}$

Statute Miles

Nautical Miles

Kilometers

SOUNDINGS IN FATHOMS
EXCEPT ON DOTTED SURFACES
WHERE SHOWN IN FEET

NOT INTENDED FOR NAVIGATION

LEGEND
Reported

OFFICE OF THE SECRETARY—REPORT NO. 100

KELP MAP

PACIFIC COAST - CALIFORNIA

SHEET No. 2

FERTILIZER INVESTIGATIONS
FRANK K. CAMERON, in charge
Mapped by W. C. Crandall.
1912

BASE MAP FROM COAST AND GEODETIC SURVEY CHART NO. 5800

Scale 1/80000

Statute Miles

Nautical Miles

Kilometers

SOUNDINGS IN FATHOMS EXCEPT ON DOTTED SURFACES WHERE SHOWN IN FEET

NOT INTENDED FOR NAVIGATION

LEGEND

Thin

Reported

OFFICE OF THE SECRETARY REPORT NO 100

U. S. DEPT. OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY, CHIEF

KELP MAP

PACIFIC COAST - CALIFORNIA

SHEET NO. 27

FERTILIZER INVESTIGATIONS.
FRANK K. CAMERON, in charge.
Mapped by W. C. Crandall.
1912

BASE MAP FROM
COAST AND GEODETIC SURVEY
CHART NO. 5800

Scale 1/200000
Statute Miles
Nautical Miles
Kilometers

SOUNDINGS IN FATHOMS
EXCEPT ON DOTTED SURFACES
WHERE SHOWN IN FEET
NOT INTENDED FOR NAVIGATION

LEGEND
Medium

OFFICE OF THE SECRETARY REPORT NO 100

U. S. DEPT. OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY, CHIEF

KELP MAP

PACIFIC COAST - CALIFORNIA

SHEET NO. 29

FERTILIZER INVESTIGATIONS.
FRANK K. CAMERON, in charge.
Mapped by W. C. Crandall.
1912

BASE MAP REDRAWN FROM
COAST AND GEODETIC SURVEY
CHART NO. 5700

Scale $\frac{1}{200000}$

Statute Miles

Nautical Miles

Kilometers

SOUNDINGS IN FATHOMS
HEIGHTS IN FEET

NOT INTENDED FOR NAVIGATION

LEGEND
Reported

OFFICE OF THE SECRETARY. REPORT NO. 100

U. S. DEPT. OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY, CHIEF

KELP MAP
PACIFIC COAST - CALIFORNIA

SHEET NO. 30

FERTILIZER INVESTIGATIONS.
FRANK K. CAMERON, in charge.
Mapped by W. C. Crandall.
1912

BASE MAP REDRAWN FROM COAST AND GEODETIC SURVEY CHART NO. 5700

U. S. DEPT. OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY, CHIEF

KELP MAP

PACIFIC COAST - CALIFORNIA

SHEET NO. 31

FERTILIZER INVESTIGATIONS.
FRANK K. CAMERON, in charge.
Mapped by W. C. Crandall.
1912

BASE MAP REDRAWN FROM COAST AND GEODETIC SURVEY CHART NO. 5700

Scale 1/80000
Statute Miles
Nautical Miles
Kilometers

SOUNDINGS IN FATHOMS
HEIGHTS IN FEET
NOT INTENDED FOR NAVIGATION

LEGEND
Thin
Heavy
Medium

OFFICE OF THE SECRETARY - REPORT NO. 100

U. S. DEPT. OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY, CHIEF

KELP MAP

PACIFIC COAST - CALIFORNIA

SHEET NO. 32

FERTILIZER INVESTIGATIONS.
FRANK K. CAMERON, in charge
Mapped by W. C. Crandall.
1912

BASE MAP REDRAWN FROM COAST AND GEODETIC SURVEY CHART NO. 5600

Scale 1/80000
Statute Miles
Nautical Miles
Kilometers

SOUNDINGS IN FATHOMS EXCEPT ON DOTTED SURFACES WHERE SHOWN IN FEET

NOT INTENDED FOR NAVIGATION

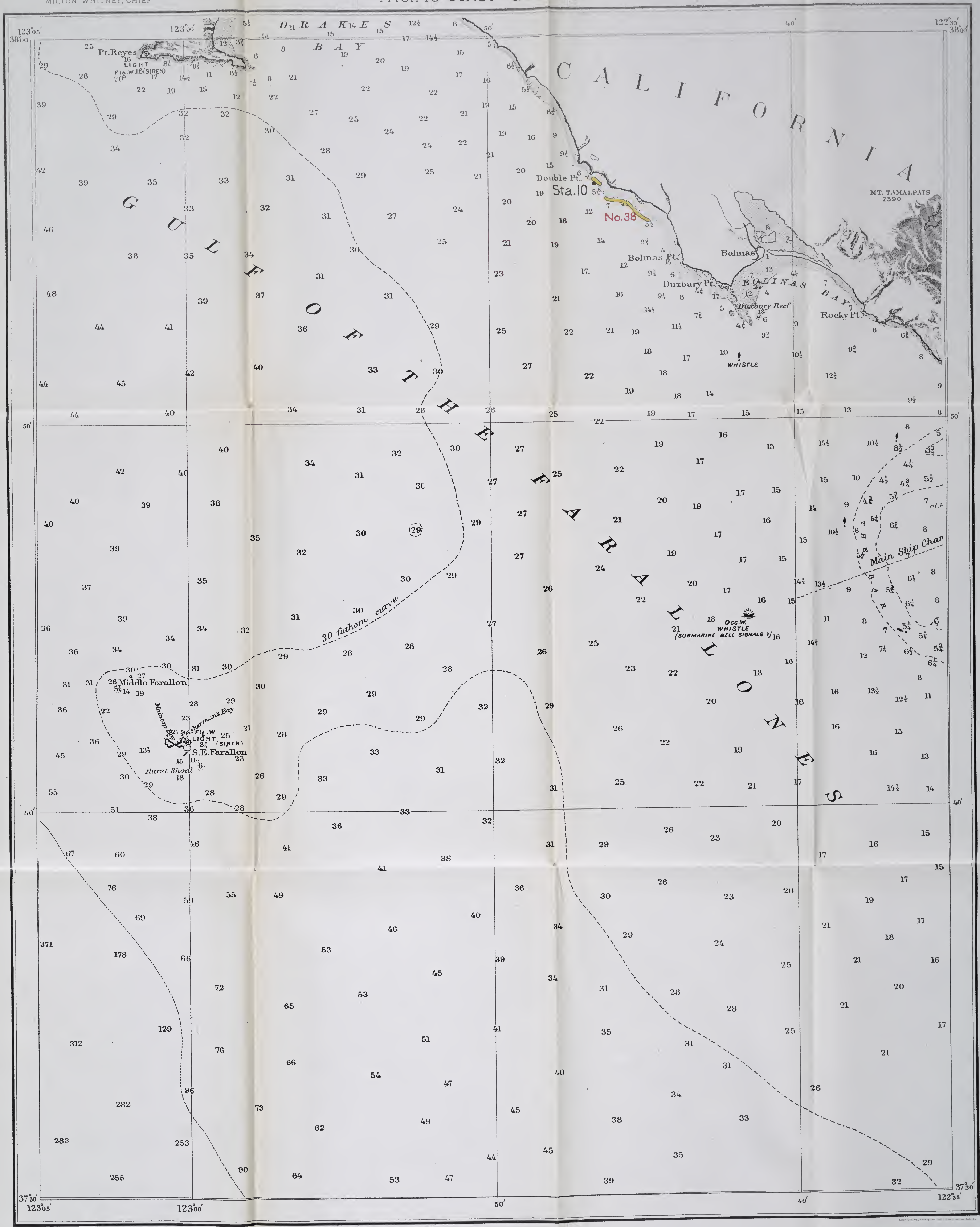
LEGEND
Thin
Medium
Medium Heavy
Heavy

U. S. DEPT. OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY, CHIEF

KELP MAP

PACIFIC COAST - CALIFORNIA

SHEET NO. 34



FERTILIZER INVESTIGATIONS
FRANK K. CAMERON, in charge.
Mapped by W. C. Crandall.
1912

BASE MAP FROM
COAST AND GEODETIC SURVEY
CHART NO. 5500

Scale
Statute Miles
Nautical Miles
Kilometers

SOUNDINGS IN FATHOMS
EXCEPT ON DOTTED SURFACES
WHERE SHOWN IN FEET

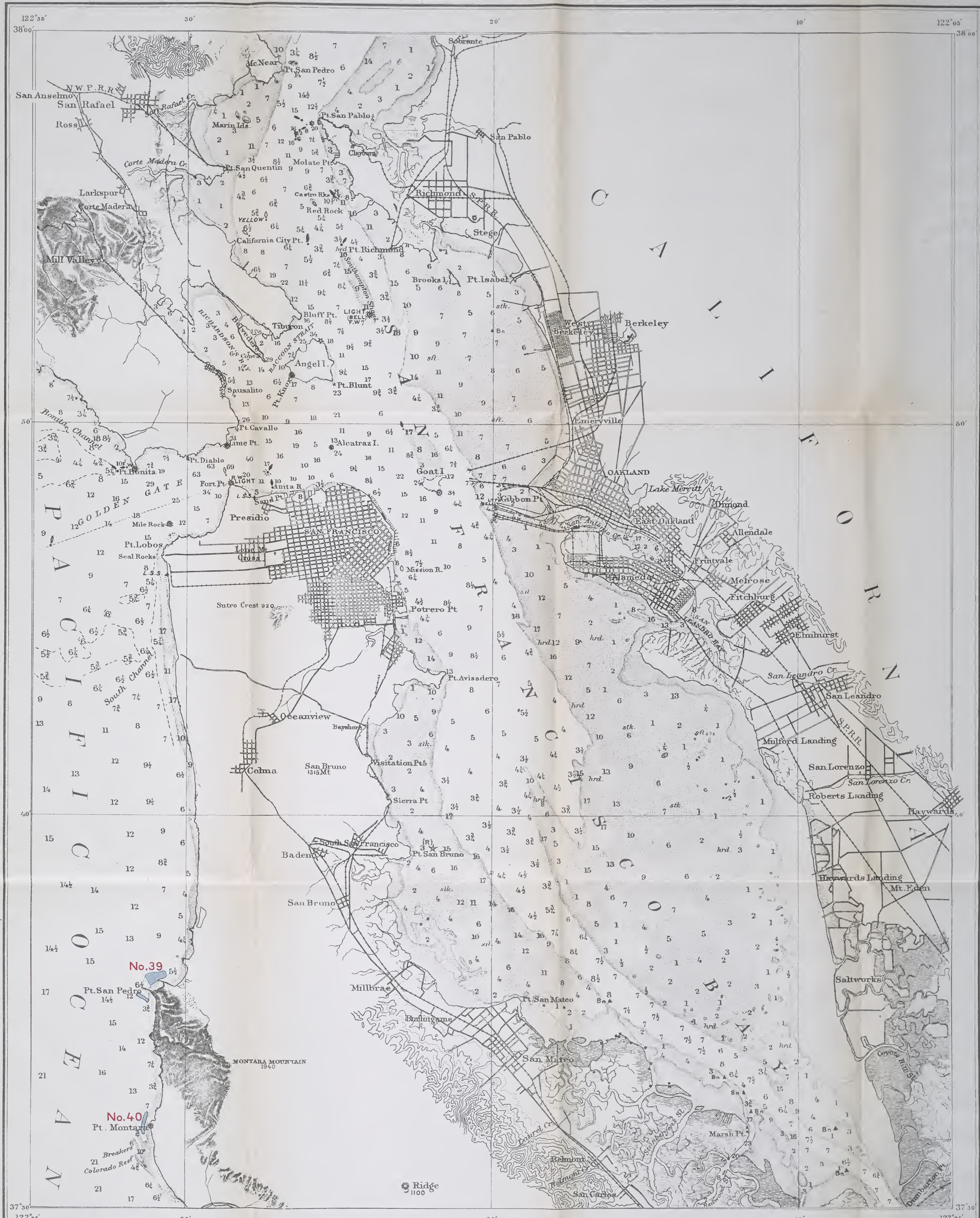
NOT INTENDED FOR NAVIGATION

U. S. DEPT. OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY, CHIEF

KELP MAP

PACIFIC COAST - CALIFORNIA

SHEET NO. 35



FERTILIZER INVESTIGATIONS
FRANK K. CAMERON, in charge
Mapped by W. C. Crandall
1912

BASE MAP FROM
COAST AND GEODETIC SURVEY
CHART NO. 5500

Scale 1/80000
Statute Miles
Nautical Miles
Kilometers

SOUNDINGS IN FATHOMS
EXCEPT ON DOTTED SURFACES
WHERE SHOWN IN FEET

NOT INTENDED FOR NAVIGATION

LEGEND
Very Thin

OFFICE OF THE SECRETARY REPORT NO. 100

U. S. DEPT. OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY, CHIEF

KELP MAP

PACIFIC COAST - CALIFORNIA

SHEET NO. 36

FERTILIZER INVESTIGATIONS.
FRANK K. CAMERON, in charge.
Mapped by W. C. Crandall.
1912

BASE MAP FROM COAST AND GEODETIC SURVEY CHART No. 5500

Scale 1/80000
Statute Miles
Nautical Miles
Kilometers

SOUNDINGS IN FATHOMS EXCEPT ON DOTTED SURFACES WHERE SHOWN IN FEET

NOT INTENDED FOR NAVIGATION

LEGEND
Thin
Medium

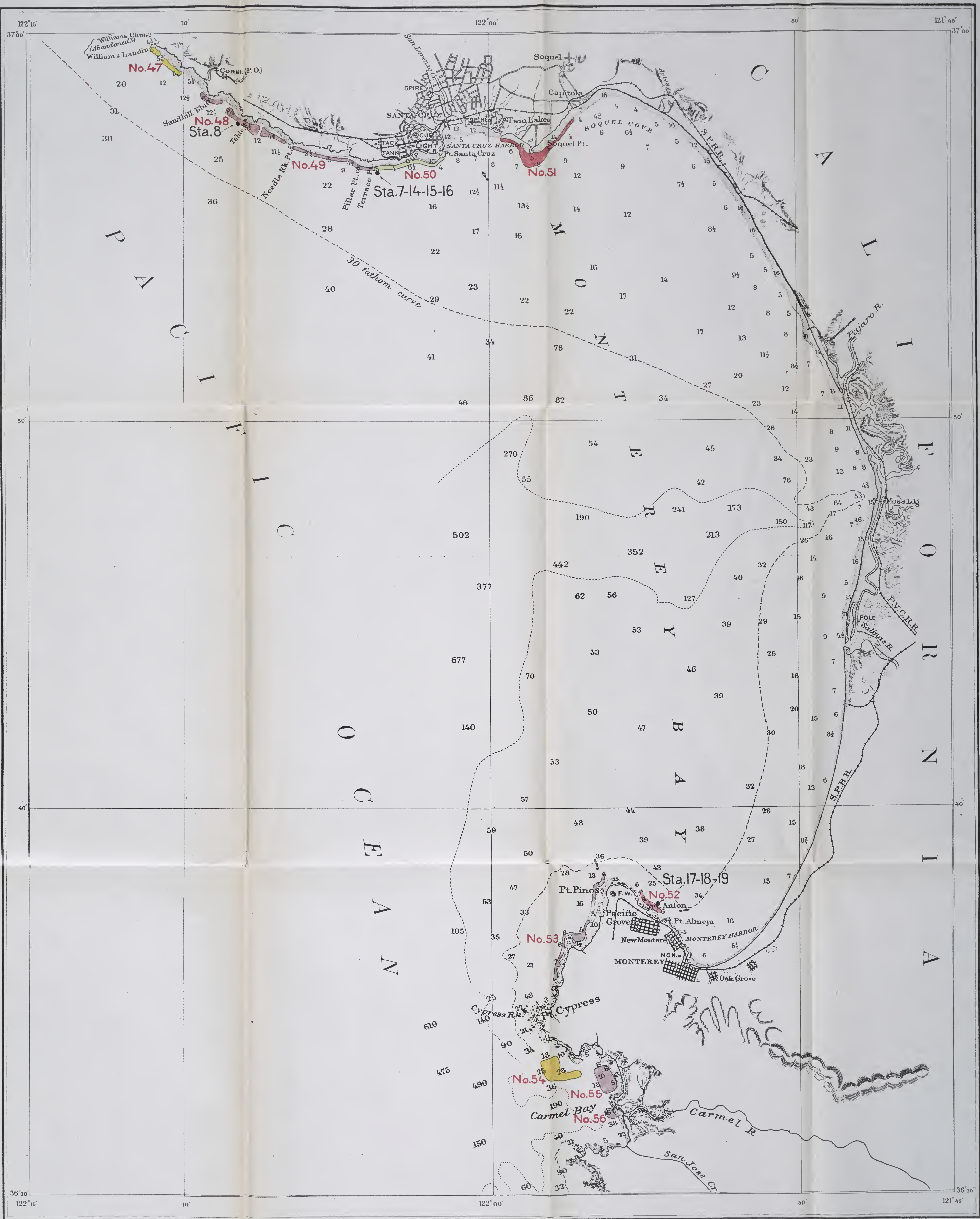
OFFICE OF THE SECRETARY REPORT NO 100

U. S. DEPT. OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY, CHIEF

KELP MAP

PACIFIC COAST - CALIFORNIA

SHEET NO. 37



FERTILIZER INVESTIGATIONS
FRANK K. CAMERON, in charge
Mapped by W. C. Crandall
1912

OFFICE OF THE SECRETARY—REPORT NO. 100

U. S. DEPT. OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY, CHIEF

KELP MAP

PACIFIC COAST - CALIFORNIA

SHEET NO. 38

FERTILIZER INVESTIGATIONS
FRANK K. CAMERON, in charge.
Mapped by W. C. Crandall.
1912

BASE MAP FROM COAST AND GEODETIC SURVEY CHART NO. 5400

Scale 1/100000
Statute Miles
Nautical Miles
Kilometers

SOUNDINGS IN FATHOMS EXCEPT ON DOTTED SURFACES WHERE SHOWN IN FEET

NOT INTENDED FOR NAVIGATION

LEGEND

Medium
Heavy
Medium Heavy
Very Heavy

U. S. DEPT OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY, CHIEF

KELP MAP

PACIFIC COAST - CALIFORNIA

SHEET NO. 39

FERTILIZER INVESTIGATIONS
FRANK K. CAMERON, in charge
Mapped by W. C. Crandall.
1912

BASE MAP FROM
COAST AND GEODETIC SURVEY
CHART NO. 5400

Scale 1/100000
Statute Miles
Nautical Miles
Kilometers

SOUNDINGS IN FATHOMS
HEIGHTS IN FEET

NOT INTENDED FOR NAVIGATION

LEGEND

Thin
Medium
Very Heavy
Medium Heavy
Heavy

OFFICE OF THE SECRETARY REPORT NO. 100

U. S. DEPT. OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY, CHIEF

KELP MAP
PACIFIC COAST - CALIFORNIA

SHEET NO. 40

FERTILIZER INVESTIGATIONS
FRANK K. CAMERON, in charge
Mapped by W. C. Crandall
1912

BASE MAP REDRAWN FROM
COAST AND GEODETIC SURVEY
CHART NO. 5300

Statute Miles
Nautical Miles
Kilometers

SOUNDINGS IN FATHOMS
HEIGHTS IN FEET

NOT INTENDED FOR NAVIGATION

LEGEND
Very Thin
Medium
Medium Heavy
Very Heavy
Reported

OFFICE OF THE SECRETARY - REPORT NO. 100

U. S. DEPT. OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY, CHIEF

KELP MAP
PACIFIC COAST - CALIFORNIA

SHEET NO. 41

FERTILIZER INVESTIGATIONS
FRANK K. CAMERON, in charge.
Mapped by W. C. Crandall.
1912

BASE MAP REDRAWN FROM
COAST AND GEODETIC SURVEY
CHART NO. 5300

Scale
Statute Miles
Nautical Miles
Kilometers

SOUNDINGS IN FATHOMS
HEIGHTS IN FEET
NOT INTENDED FOR NAVIGATION

LEGEND
Very Thin
Very Heavy

KELP MAP

PACIFIC COAST - CALIFORNIA

FERTILIZER INVESTIGATIONS.
FRANK K. CAMERON, in charge.
Mapped by W. C. Crandall
1912

BASE MAP REDRAWN FROM COAST AND GEODETIC SURVEY CHART NO. 5300

Statute Miles

Nautical Miles

Kilometers

SOUNDINGS IN FATHOMS
HEIGHTS IN FEET

NOT INTENDED FOR NAVIGATION

LEGEND

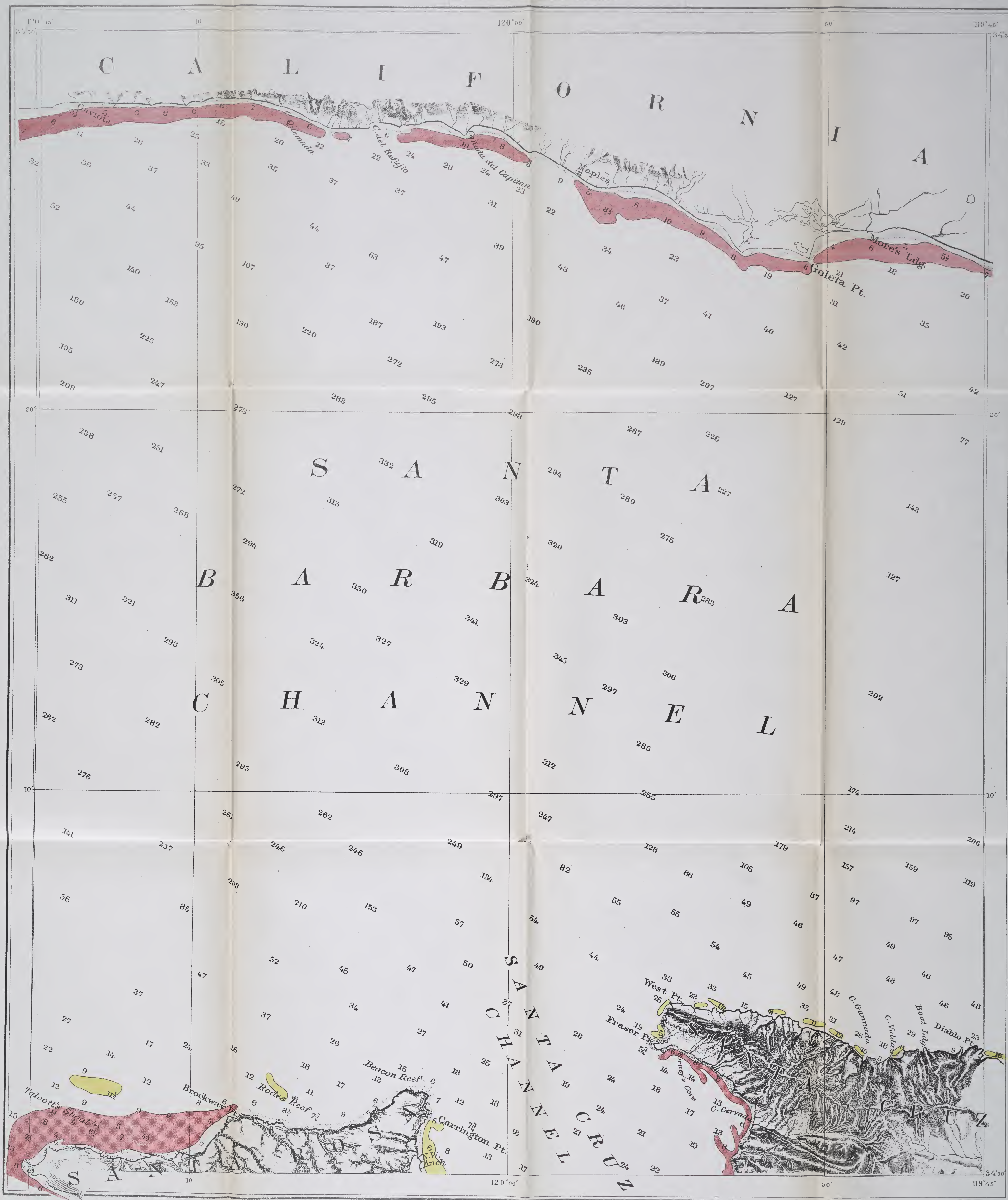
Thin
Medium
Heavy
Very Heavy

U. S. DEPT. OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY, CHIEF

KELP MAP

PACIFIC COAST - CALIFORNIA

SHEET NO. 43



FERTILIZER INVESTIGATIONS
FRANK K. CAMERON, in charge.
Mapped by W. C. Crandall.
1912

BASE MAP FROM
COAST AND GEODETIC SURVEY
CHART NO. 5200

Scale 1/200000
Statute Miles
Nautical Miles
Kilometers

SOUNDINGS IN FATHOMS
HEIGHTS IN FEET

NOT INTENDED FOR NAVIGATION

LEGEND

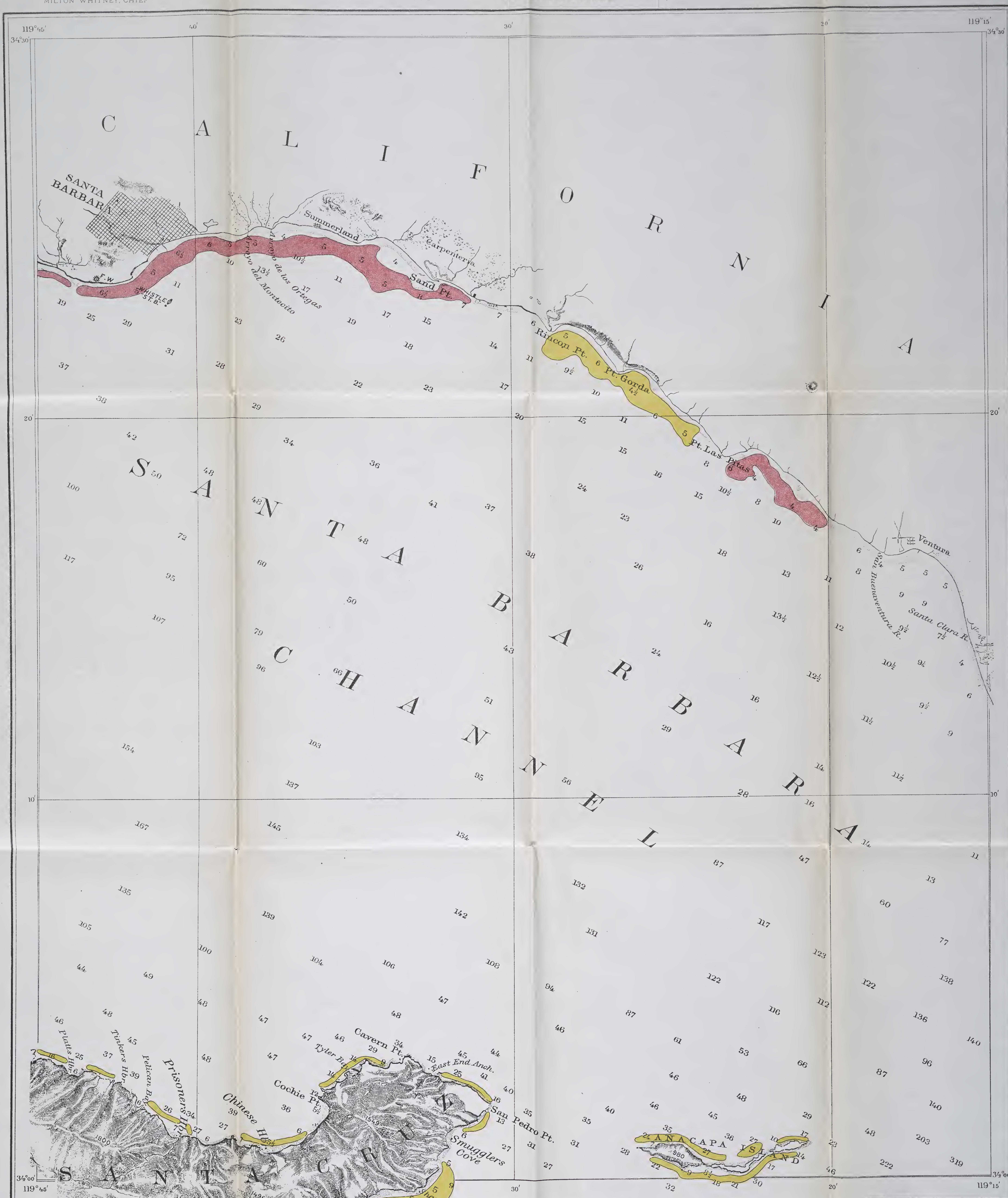
Thin
Medium

U. S. DEPT. OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY, CHIEF

KELP MAP

PACIFIC COAST - CALIFORNIA

SHEET NO. 44



FERTILIZER INVESTIGATIONS.
FRANK K. CAMERON, in charge.
Mapped by W. C. Crandall.
1912

BASE MAP FROM
COAST AND GEODETIC SURVEY
CHART NO. 5200

Scale 1/200000

SOUNDINGS IN FATHOMS
HEIGHTS IN FEET

NOT INTENDED FOR NAVIGATION

OFFICE OF THE SECRETARY—REPORT NO. 100

KELP MAP
PACIFIC COAST - CALIFORNIA

U. S. DEPT. OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY, CHIEF

SHEET NO. 45

FERTILIZER INVESTIGATIONS
FRANK K. CAMERON, in charge
Mapped by W. C. Crandall
1912

BASE MAP FROM
COAST AND GEODETIC SURVEY
CHART NO. 5200

Statute Miles

Nautical Miles

Kilometers

SOUNDINGS IN FATHOMS
HEIGHTS IN FEET

NOT INTENDED FOR NAVIGATION

LEGEND

Thin

Heavy

U. S. DEPT. OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY, CHIEF

KELP MAP
PACIFIC COAST - CALIFORNIA

SHEET NO. 46

FERTILIZER INVESTIGATIONS.
FRANK K. CAMERON, in charge.
Mapped by W. C. Crandall.
1912

BASE MAP FROM
COAST AND GEODETIC SURVEY
CHART NO. 5200

OFFICE OF THE SECRETARY REPORT NO. 100


U. S. DEPT. OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY, CHIEF
KELP MAP
PACIFIC COAST - CALIFORNIA
SHEET NO. 47
Santa Monica
Port Ballona
Ballona Cr.
Redondo Beach
Oil Well
Malaga Cove
Rocky Pt.
Pt Vicente
San Pedro Hill
San Pedro
Wilmington
Pt Fermin
Kellers Shelter
Malaga Cr.
SANTA MONICA BAY
CALIFORNIA
PACIFIC OCEAN
SAN PEDRO CHANNEL
10 fathom curve
100 fathom curve
A.T.& S.F.R.R.
LIGHT
WHISTLE
BELL
FERTILIZER INVESTIGATIONS.
FRANK K. CAMERON, in charge.
Mapped by W. C. Crandall.
1912
BASE MAP FROM
COAST AND GEODETIC SURVEY
CHART NO. 5100
Statute Miles
Nautical Miles
Kilometres
SOUNDINGS IN FATHOMS
HEIGHTS IN FEET
NOT INTENDED FOR NAVIGATION
LEGEND
Thin
Medium
OFFICE OF THE SECRETARY REPORT NO 100

U. S. DEPT. OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY, CHIEF

KELP MAP

PACIFIC COAST - CALIFORNIA

SHEET NO. 49

FERTILIZER INVESTIGATIONS.
FRANK K. CAMERON, in charge.
Mapped by W. C. Crandall.
1912

BASE MAP FROM
COAST AND GEODETIC SURVEY
CHART NO. 5200

SOUNDINGS IN FATHOMS
HEIGHTS IN FEET

NOT INTENDED FOR NAVIGATION

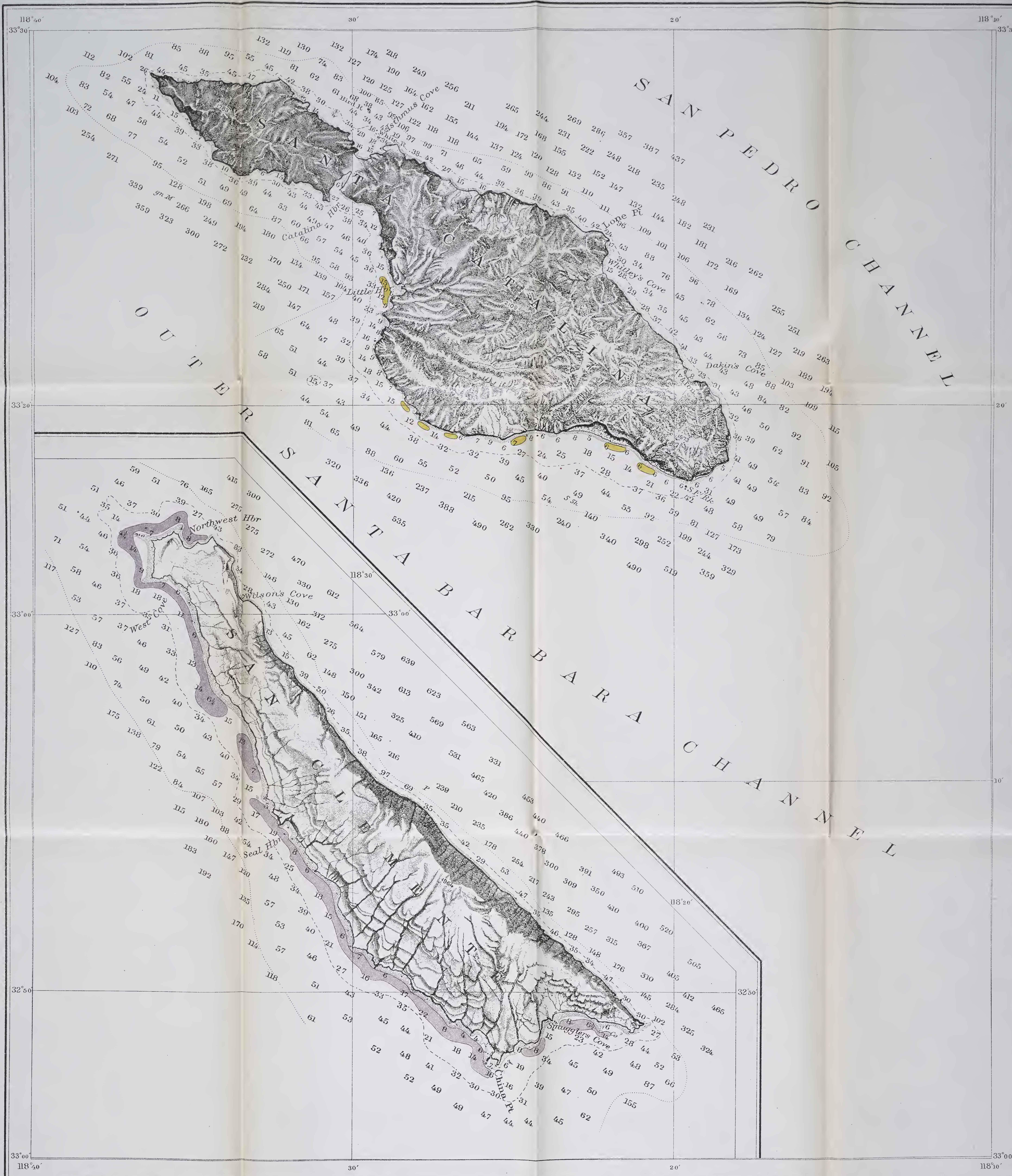
OFFICE OF THE SECRETARY REPORT NO. 100

U. S. DEPT. OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY, CHIEF

KELP MAP

PACIFIC COAST - CALIFORNIA

SHEET NO. 50



FERTILIZER INVESTIGATIONS.
FRANK K. CAMERON, in charge.
Mapped by W. C. Crandall.
1912

BASE MAP FROM
COAST AND GEODETIC SURVEY
CHART NO. 5100

Statute Miles
Nautical Miles
Kilometers

SOUNDINGS IN FATHOMS
HEIGHTS IN FEET

NOT INTENDED FOR NAVIGATION

LEGEND
Thin
Heavy

OFFICE OF THE SECRETARY. REPORT NO. 100

U. S. DEPT. OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY, CHIEF

KELP MAP

PACIFIC COAST - CALIFORNIA

SHEET NO. 51

FERTILIZER INVESTIGATIONS.
FRANK K. CAMERON, in charge.
Mapped by W. C. Crandall.
1912

BASE MAP FROM
COAST AND GEODETIC SURVEY
CHART NO. 5100

Scale 1/80000
Statute Miles
Nautical Miles
Kilometers

SOUNDINGS IN FATHOMS
HEIGHTS IN FEET

NOT INTENDED FOR NAVIGATION

LEGEND
Thin
Medium

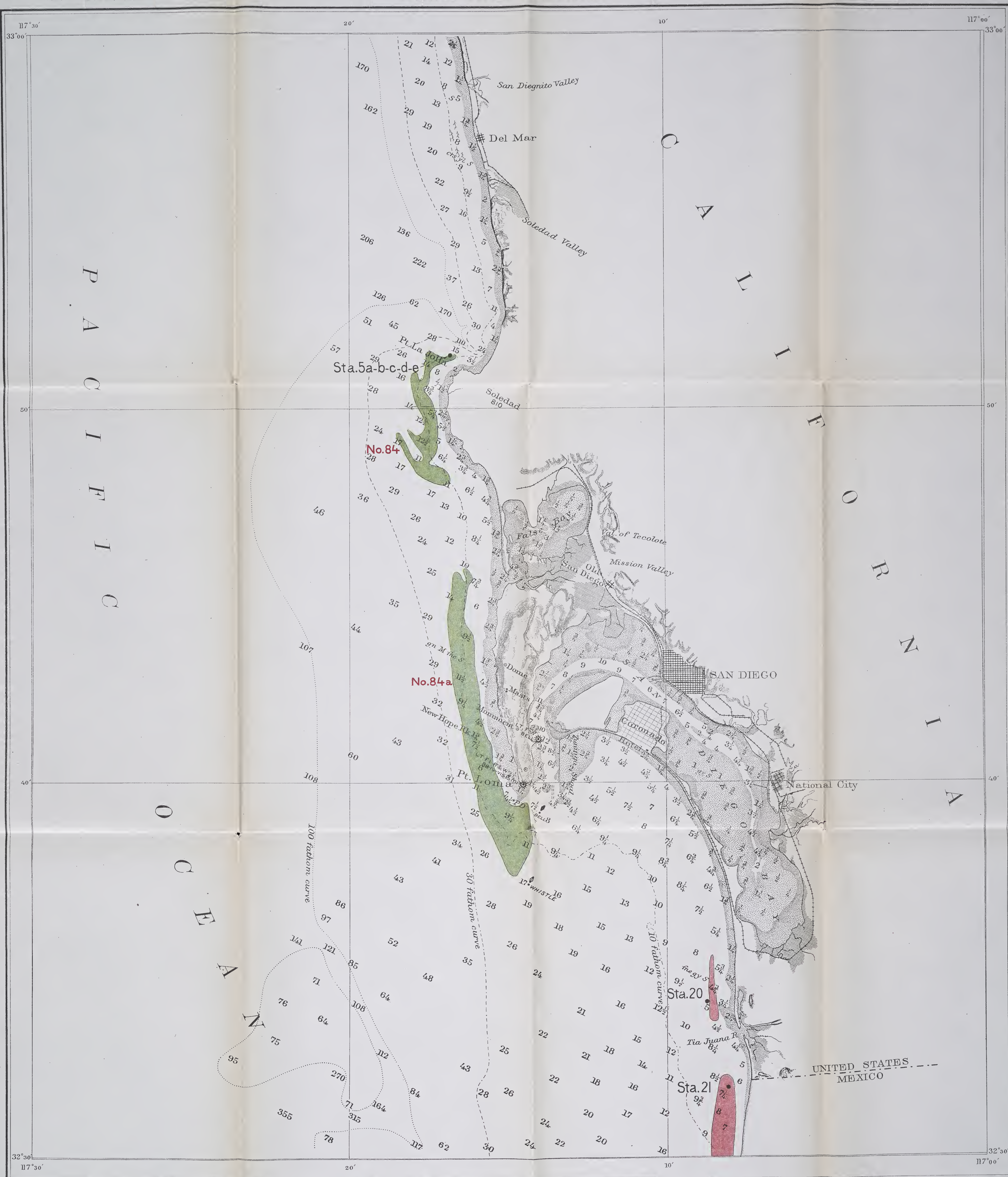
OFFICE OF THE SECRETARY—REPORT NO. 100

U. S. DEPT. OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY, CHIEF

KELP MAP

PACIFIC COAST - CALIFORNIA

SHEET NO. 52



FERTILIZER INVESTIGATIONS.
FRANK K. CAMERON, in charge.
Mapped by W. C. Crandall.
1912

BASE MAP FROM
COAST AND GEODETIC SURVEY
CHART NO. 5100

Statute Miles
Nautical Miles
Kilometers
SOUNDINGS IN FATHOMS
HEIGHTS IN FEET
NOT INTENDED FOR NAVIGATION

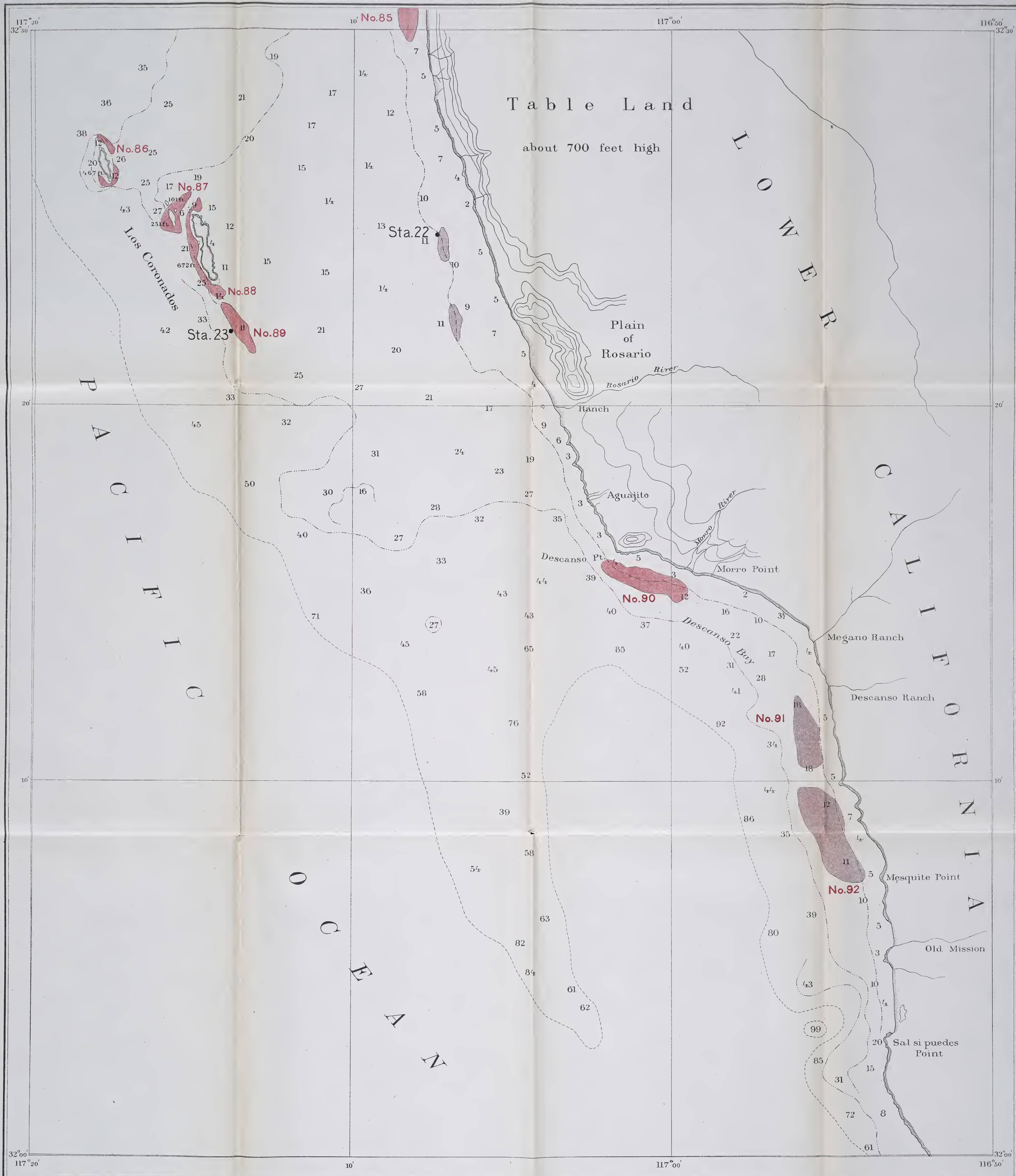
LEGEND
Medium
Very Heavy

OFFICE OF THE SECRETARY REPORT NO. 100

U. S. DEPT. OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY, CHIEF

KELP MAP

PACIFIC COAST - LOWER CALIFORNIA



FERTILIZER INVESTIGATIONS.
FRANK K. CAMERON, in charge.
Mapped by W. C. Crandall.
1912

BASE MAP REDRAWN FROM COAST AND GEODETIC SURVEY CHART NO. 1149

Scale $\frac{1}{200000}$

Statute Miles

Nautical Miles

Kilometres

SOUNDINGS IN FATHOMS
HEIGHTS IN FEET
NOT INTENDED FOR NAVIGATION

LEGEND

Medium

Heavy

U. S. DEPT. OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY, CHIEF

KELP MAP
PACIFIC COAST - LOWER CALIFORNIA

SHEET NO. 54

FERTILIZER INVESTIGATIONS.
FRANK K. CAMERON, in charge.
Mapped by W. C. Crandall.
1912

BASE MAP REDRAWN FROM COAST AND GEODETIC SURVEY CHART NO. 1149

Scale $\frac{1}{200000}$
Statute Miles
Nautical Miles
Kilometers

SOUNDINGS IN FATHOMS
HEIGHTS IN FEET

NOT INTENDED FOR NAVIGATION

LEGEND
Medium
Heavy
Medium Heavy
Very Heavy

OFFICE OF THE SECRETARY - REPORT NO. 100

U. S. DEPT. OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY, CHIEF

KELP MAP
PACIFIC COAST - LOWER CALIFORNIA

SHEET NO. 55

FERTILIZER INVESTIGATIONS
FRANK K. CAMERON, in charge
Mapped by W. C. Crandall
1912

BASE MAP REDRAWN FROM
COAST AND GEODETIC SURVEY
CHART NO. 1149

Statute Miles

Nautical Miles

Kilometers

SOUNDINGS IN FATHOMS
HEIGHTS IN FEET

NOT INTENDED FOR NAVIGATION

LEGEND

Medium

Very Heavy

OFFICE OF THE SECRETARY. REPORT NO. 100

U. S. DEPT. OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY, CHIEF

KELP MAP
PACIFIC COAST - LOWER CALIFORNIA

SHEET NO. 56

FERTILIZER INVESTIGATIONS
FRANK K. CAMERON, in charge
Mapped by W. C. Crandall
1912

BASE MAP REDRAWN FROM COAST AND GEODETIC SURVEY CHART NO. 1148

Statute Miles
Nautical Miles
Kilometers

SOUNDINGS IN FATHOMS
HEIGHTS IN FEET

NOT INTENDED FOR NAVIGATION

LEGEND
Medium
Heavy
Very Heavy

OFFICE OF THE SECRETARY—REPORT NO. 100

U. S. DEPT. OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY, CHIEF

KELP MAP

PACIFIC COAST - LOWER CALIFORNIA

SHEET NO. 57

FERTILIZER INVESTIGATIONS
FRANK K. CAMERON, in charge
Mapped by W. C. Crandall.
1912

BASE MAP REDRAWN FROM
COAST AND GEODETIC SURVEY
CHART NO. 1149

SOUNDINGS IN FATHOMS
HEIGHTS IN FEET

NOT INTENDED FOR NAVIGATION

LEGEND

Heavy

Very Heavy

OFFICE OF THE SECRETARY—REPORT NO. 100

U. S. DEPT. OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY, CHIEF

KELP MAP
PACIFIC COAST - LOWER CALIFORNIA

SHEET NO. 58

FERTILIZER INVESTIGATIONS
FRANK K. CAMERON, in charge
Mapped by W. C. Crandall.
1912

BASE MAP REDRAWN FROM
COAST AND GEODETIC SURVEY
CHART NO. 1149

Scale
Statute Miles
Nautical Miles
Kilometers

SOUNDINGS IN FATHOMS
HEIGHTS IN FEET

NOT INTENDED FOR NAVIGATION

LEGEND
Medium Heavy
Heavy
Very Heavy

OFFICE OF THE SECRETARY - REPORT NO. 100

U. S. DEPT. OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY, CHIEF

KELP MAP
PACIFIC COAST - LOWER CALIFORNIA

SHEET NO. 60

FERTILIZER INVESTIGATIONS
FRANK K. CAMERON in charge
Mapped by W. C. Crandall
1912

BASE MAP REDRAWN FROM
COAST AND GEODETIC SURVEY
CHART NO. 1149

OFFICE OF THE SECRETARY REPORT NO. 100

U. S. DEPT. OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY, CHIEF

KELP MAP
PACIFIC COAST - LOWER CALIFORNIA

SHEET NO. 61

FERTILIZER INVESTIGATIONS.
FRANK K. CAMERON, in charge.
Mapped by W. C. Crandall.
1912

BASE MAP REDRAWN FROM COAST AND GEODETIC SURVEY CHART NO. 1149

Statute Miles
Nautical Miles
Kilometers
SOUNDINGS IN FATHOMS
HEIGHTS IN FEET
NOT INTENDED FOR NAVIGATION

LEGEND
Very Heavy

OFFICE OF THE SECRETARY - REPORT NO. 100